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THE DIFFERENCE BETWEEN THE OLDER AND THE NEWER TREATMENTS BY X-RAY AND RADIUM IN GYNECOLOGICAL DISEASES[1]

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I WISH briefly to sum up the indications for röntgen treatment of myomata of the uterus. Röntgen treatment is indicated for myomata in all cases of women of forty years or over in place of the total extirpation of the genital organs or in place of the supravaginal removal of the uterus. This röntgen treatment is preferable in my opinion, first, because it causes no deaths; second, because it can be used even after serious weakening from the loss of blood, and in cases of heart troubles. I also mention the disadvantages of this mode of treatment. First, the greater expense; second, the longer time required by from six to eight treatments extending over a period of three to four months. In cases of younger women whose menstruation and fertility must be preserved, we prefer operation and enucleation, where possible, to röntgen treatment. It is to be regretted that long experience shows that after the enucleation of myomata recidives often occur and bleeding starts afresh after but a short interval. As experience shows that permanent success can be looked for only in cases where the tumors are isolated; there arise a large number of cases, the majority in fact, in which even in women under forty röntgen treatment is indicated in preference to operation.

I do not wish to refrain from mentioning the fact that röntgen treatment harbors a certain danger that arises from uncertainty of diagnosis. Ovarian tumors cannot be reached by röntgen treatment and must be excluded. In some cases tumors of the uterus have grown together with tumors of the ovaries, making differential diagnosis impossible. In these cases operations must be performed. Another difficulty arises from mixed tumors where myoma exist in combination with sarcoma or carcinoma. Carcinomata, arising from the mucous membrane, as they do, can be revealed by curettage and microscopic examination.

Sarcoma of the wall cannot be diagnosed by curettage. This difficulty has been emphasized by those who oppose röntgen treatment as a ground for universal use of the operation.

From the clinic of Professor Bumm at Berlin there appeared recently a treatise in which the frequence of sarcoma was stated as ten per cent of all tumors of the uterus. This high percentage must be the result of accidental causes that are by no means normal. The investigations of others and especially the fundamental work of Cullen and Kelly, in which the whole literature of all countries bearing upon this subject has been brought

[1] Read before the Clinical Congress of Surgeons of North America, November, 1913. Also read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

together with a most wonderful thoroughness, establishes the fact that sarcoma occurs only in one per cent of all cases of tumors of the uterus.

For the clinic at Freiburg, our pathologist, Professor Aschoff, examined microscopically a series of four hundred tumors of the uterus that had been previously removed by me. He found sarcoma present in approximately one per cent of the cases. The apparent danger is minimized by the fact that sarcoma occurs in but one per cent of the cases.

Further, it must be borne in mind that it is by no means uncertain that röntgen treatment will not influence sarcoma-cells in exactly the same way as the myoma-cells. As I reported at the previous meeting, we treated a series of 350 cases of tumors of the uterus with röntgen rays, and all were successful in stopping the bleeding and the reduction in the size of the tumors, and so far as we are able to ascertain, there has been no relapse. In accordance with the previous statistics showing one per cent of sarcoma we should expect in this series three or four cases of sarcoma. Since no tumor grew during treatment or afterwards so far as we could ascertain, it must be assumed that the three or four cases of sarcoma to be expected if they actually occurred were cured by the röntgen treatment.

I believe that I have defined the broad limits for the use of röntgen treatment as against the operative treatment. Dr. Gauss will speak about the technique of the treatment. I cannot, however, close this short discussion without first mentioning the fact that röntgen rays and radium, while valuable and effective, are also dangerous, when used without proper precautions. It requires considerable experience to obtain good results.

As I am speaking to an audience of obstetricians and gynecologists, I will, with the permission of the president, spend a few minutes in discussing an obstetrical procedure, in which we at the Freiburger Clinic have taken an especial interest. I mean the securing of painless delivery by the use of scopolamine-morphine seminarcosis. This special phase of narcosis we have named "Dämmerschlaf," which translated into English would be "twilight sleep." Our clinic has experience covering three thousand births effected under the influence of this drug.

The desire to lighten the pains of parturition is inherent in all civilization that is worthy of the name. With the increasing demands of brainwork naturally goes a keener sensitiveness to all shocks which may accompany pregnancy, and, therefore, to the shocks given by pains. If we hear to-day that it is just in the very civilized and cultivated circles that so great a number of women undergo difficult and surgically-assisted parturition, we know that the cause is not to be sought for in the fact of greater resistance owing to narrow or contracted pelvis nor in the failing activity of labor pains and lack of muscular power. We all know that narrow pelvis is particularly rare in the better classes and also that owing to the prevalence of sport, muscular weakness in the upper classes is very seldom met with. The great number of operative deliveries is to be accounted for by the fact that modern woman has not the strength to resist the nervous exhaustion which is caused by the apperception of pains. We do not deny that by means of narcotic inhalations, chloroform, ether, and laughing-gas many cases in childbirth can be painlessly delivered. Nevertheless these measures are not quite satisfactory. First, because they make such great demands upon the obstetrician, and, secondly, when persevered in for a considerable time they materially diminish the efficacy of the labor.

In our clinic, my assistant, Dr. Gauss, has worked out a method with the use of narcotic injections of scopolamine and the observance of quite definite measures, which we have found to answer excellently in a series of about three thousand deliveries. This method rests upon the administration of a seminarcosis, a state of "Dämmerschlaf;" *i. e.*, a state during which the woman concerned has indeed a perception of pain, but not an apperception. She still reacts to the labor-pains with an expression of pain, but afterwards she has no recollection of the pain experienced.

Scopolamine-morphine is given in small

doses, frequently repeated as a hypodermic injection. The entire technique depends upon the dosage. Two opposite extremes must be avoided: if too much is given in order to bring about a full narcosis from which all expression of pain is absent the labor pains cease, and there arises the danger of atonic bleeding. On the other hand, if too little is administered the pains are perceived and also apperceived. They are remembered, and the nervous exhaustion which this narcosis is designed to avoid arises as if no narcosis had been induced. Between these two limits lies the region of "twilight sleep." You all know this condition. When you give a few drops of ether at the beginning of each labor pain there arises a condition akin to drunkenness, the patient cries, gives expression to pain, but afterwards remembers little or nothing; identically the same condition can be brought about by the injection of scopolamine-morphine, or, as we have latterly learned, by scopolamine-narcophine.

The quantity given must be regulated by a psychological index, namely, by frequently repeated tests of the memory, for it is a peculiar quality of the alkaloid of scopolamine that affects memory in such an intensive and peculiar way. The tests begin after the first two standard doses which are given after an interval of three-quarters of an hour. The first dose 0.00045 scopolamine combined with 0.03 of narcophine, the second dose 0.00045 of scopolamine alone. Half an hour after the second dose, the woman is asked whether she remembers that half an hour previously she was stuck with a needle, or that she saw a watch or some other object that was shown to her at that time. If she remembers, the desired effect has not yet been achieved; if however, she does not remember, she has passed into the desired condition of semi-narcosis. The tests are repeated at intervals of a half-hour and when the recovery of memory occurs the injections are repeated as needed. Recently we attempted to bring about a standardization of the dosage of this "twilight sleep" in order to simplify the procedure. We were able to begin this only after we had gathered a very large experience and after Professor Straub had succeeded in providing scopolamine of uniform and standard strength. In a series of one hundred fifty cases we found that when the dosage and time of scopolamine were regulated in accordance with the schedule posted on the wall, in the cases of women of average strength and good health the desired degree of narcosis resulted.

We believe on a basis of our experience with over three thousand cases in which no detrimental results ever occurred for the mother that we are safe in recommending this drug as not dangerous to mothers. It must be admitted in some cases the frequence of pains is slightly reduced, but our calculations show that the average duration of birth has been increased by only half an hour. We do not want to omit mentioning the disadvantages of this procedure.

The disadvantages of this method consist in the fact that with some women, especially when the surroundings are not very quiet, transitory states of confusion of mind and excitement occur. These are of no material importance, so long as the relations of the mother do not remain in the room, for these states of excitability make an unpleasant impression on the family. In consequence of this, we only carry out the method of "twilight sleep" in cases where the relations promise to be out of the room during the whole time of the birth.

A further disadvantage of the method is that, owing to the absorption of the tiniest amount of scopolamine and narcophine by the child, occasionally an apnœa sets in during the first moments of its life outside the womb and the child only begins to breathe after a certain time, by the operation of the carbonic acid gas.

We must assume, as would happen in the case of any other narcotic, a temporary passage of the scopolamine through the child's body during birth, yet Holzbach's experimental investigations have shown that the scopolamine, of which only the most infinitesimal traces were present, is completely eliminated from the body in the urine within two hours after birth. It is, therefore, justifiable to assume that any action on the child is practically negligible. This is confirmed by the fact that the child mortality at birth has

not increased in the least, and indeed if anything has diminished. If in spite of this we have touched upon the question of the after-effects of scopolamine, we have done so with the object of taking into consideration as far as possible every conceivable disadvantage to the child. Hoche, of the Department for Mental Diseases of the University of Freiburg, who has an extremely wide experience of the action of scopolamine, has on theoretical grounds repudiated the idea that injurious effects might first make their appearance in the child years later. We did not, however, content ourselves with these theoretical considerations. The most exhaustive inquiries were made regarding five hundred children one year old, who at their birth had been exposed to the action of scopolamine and we succeeded in tracing four hundred and twenty of them. Eleven per cent had died in their first year. This is a very favorable figure, when we consider that the death-rate for children under one year old in Baden is identical. We are certainly justified in concluding from this that children in the year immediately following their birth experience no ill effects from the scopolamine administered to their mothers.

The great number of cases has, I think, provided a proof that the small quantities given by us of scopolamine and morphine or narcophine eliminates all probability of danger for the mother, and also, as I have just explained, for the child. The decreasing capacity for resisting pain shown by cultured, civilized women seems to us urgently to call for measures which can reduce the pains of childbirth.

THE TREATMENT OF BLOOD-VESSEL INJURIES[1]

By W. W. GRANT, M. D., Denver

I AM encouraged to present this subject for consideration chiefly because of its seeming neglect, and the absence of any approach to uniformity, or the application of scientific surgical principles to the treatment of hæmorrhage and its common sequel, shock, by a good many men who are doing surgical work. I wish to acknowledge, in the preparation of this paper, my indebtedness especially to the recent work of Stevenson, "Wounds in War," "The Surgery of the Vascular System," by Burnheim of Johns Hopkins, Lejars' "Wounds and Ruptures of the Great Vessels," and Lexer Bevan, "Surgery."

Not a year passes that every active surgeon does not know of the sacrifice of limb or life by an untimely or unnecessary operation from injury, or from hæmorrhage from a damaged blood-vessel, or shock from secondary hæmorrhage from not ligating or suturing the injured vessel. Necessarily the conditions come under the head of urgent surgery, which demands ready wit and prompt, skillful, yet deliberate, action on the part of the surgeon. There is no more severe test of his judgment than the action required to arrest dangerous hæmorrhage. In the embarrassment and confusion of the environment and attendant circumstances, the doubtful or wrong thing is not infrequently done. In military action, eighty-five per cent of the deaths on the field are due to hæmorrhage.[2] The smaller the bullet and the greater its velocity, the cleaner the cut, or wound, of the vessel, whether at right angles to the vessel, or tangentially; therefore, the greater, or more profuse, the hæmorrhage. If the vessel-wall is grazed or contused, the danger of secondary hæmorrhage from sloughing is great. If the coats of the vessel are only partially severed, the hæmorrhage is more severe and dangerous than if the entire continuity is divided. In the former, retraction and contraction are inhibited; in the latter, the reverse, the elastic intima, especially, contracting and receding to a greater extent, a condition favoring the

[2] Wounds in War, p. 117. Stevenson.

[1] Read before the Western Surgical Association, St. Louis, Mo., December 19, 1913.

rapid formation of thrombus. As shock aids the coagulation, by lowering the blood-pressure and impairing the vascular tonus, its first effect is *conservative*, in the arrest of primary hæmorrhage. Lacerated vessels bleed less than clean-cut wounds. Secondary hæmorrhage in a clean wound will not occur if both sides of the wounded vessel are ligated, or sutured, at the seat of the injury, primarily. In the establishment of collateral circulation, there will be recurrence of hæmorrhage from the distal end of the injured vessel if it is not ligated or sutured. In the medical records of recent wars, the mortality from ligation at the site of injury for secondary hæmorrhage is much less than from any form of compression or amputation, varying from forty-three per cent in our own Civil War to twenty-five per cent in the Boer War. The Hunterian operation is more unsuccessful and fatal, the mortality being thirty-six per cent in secondary hæmorrhage. Notwithstanding the axiomatic principle that general anæsthesia and the trauma of operation should not be superadded to the severe shock already existing, it is too often, for different reasons, not respected or recognized in practice. In civil practice, the procedure should be different from that which may be perfectly justifiable in military surgery. The better environment and equipment of the former imperatively demand more conservative methods, and when necessary, or advisable, the more elaborate and available technique.

When the caliber of a large artery, with or without its companion vein, of the extremities is opened by a bullet, or sharp instrument, free immediate hæmorrhage results. The sharper and smoother the instrument, the greater the hæmorrhage. When not immediately fatal, the patient is in severe, if not profound, shock. The first duty of the surgeon is to immobilize the limb and use the ordinary methods of compression to control hæmorrhage, temporarily, and then to devote his energies to the promotion of reaction by external heat, salt infusion by rectum, or venous transfusion, and, if loss of blood and severity of shock justifies it, direct blood transfusion as perfected by Crile, and the use of such heart stimulants as one's experience may justify; but it must not be forgotten that the most urgent and necessary heart stimulant is a fair volume of blood in the arteries. The heart beats will not be quickened nor strengthened unless the vessels are adequately filled with serum or normal blood.

When reaction is established, the second consideration is to prevent an immediate recurrence of the hæmorrhage, also the danger of secondary hæmorrhage at a later date, usually from the fifth to the tenth day. Any method of treatment which does not involve, or include, as a necessary requisite operation on the damaged vessel itself, suture or ligation at the seat of injury, will be dangerous and frequently fatal to the integrity of life or limb. In a ragged wound, the thrombus is more rapidly formed at the site of the injured vessel. It becomes partially organized and temporarily plugs the vessel. As the volume of blood is restored, the thrombus cannot be relied upon to resist the *vis a tergo*, or increased heart beats, until well organized. As a result, a clot is generally dislodged and, in some cases, conclusively indicated by a little fresh arterial blood from the wound within a week, which is a forerunner of more severe hæmorrhage to follow. At this stage the embarrassments and difficulties are greater than in the primary hæmorrhage, and, for its treatment, requires prompt, acute surgical judgment as well as skillful surgical technique.

Carrel has demonstrated that a circular end-to-end suture of an artery is not followed by either secondary hæmorrhage or aneurism. Its success in the human subject has been repeatedly demonstrated. The first arterial suture was by Hallowell in 1759. Horach was the first to try an end-to-end suture in 1888. Abbe succeeded in using a glass bobbin in 1894 which was afterwards elaborated by Murphy with the first circular suture in 1897, and Carrel's teacher — Jaboulay, and Briau, while the first arteriovenous anastomosis was by Hubbard in 1906 for gangrene of the leg. "If the artery is essential to the life of the part which it supplies, it should be closed by end or lateral suture, depending

upon the character of the injury. If not essential, it may be ligated above and below the point of injury.[1]" "If the diagnosis of injury to an artery is made, with or without simultaneous injury of a vein, the point of injury should be exposed, even if there is no external hæmorrhage, blood-clots removed, and the vessel ligated or sutured.[2]"

Besides the local and general condition, the application of a stethoscope to the seat of injury will aid in the diagnosis by revealing a blowing sound, or bruit.

Gangrene of leg follows 50 per cent of cases of ligation of the popliteal artery, 20 per cent of the femoral, 50 per cent of both femoral artery and vein, 1 to 2 per cent of the femoral vein alone.[3] "It must be accepted as a maxim that the preservation of the blood and nerve supply, rather than the condition of the bone and soft tissues, is the most important consideration in the preservation of the limb. Primary amputation is indicated only when the principal vessels and nerves are involved with extensive destruction of bone and soft parts.[4]

The occlusion of the axillary, the brachial, the femoral, and popliteal may not be considered fatal to the nutrition and preservation of the limb distal to the injured part, but the integrity of these vessels is so necessary and important that the condition should be treated as if they were absolutely essential to the preservation of the limb. The first consideration, after reaction, should be, in case of injury to such vessels, to explore the wound, guided by the track of the bullet or implement to the seat of injury, and the vessel treated in accordance with the equipment and technique fully described by Carrel or Burnheim.[5] This is the ideal treatment, but in the absence of the necessary equipment and conditions for its performance, the next step, which should be imperative, is ligation of the vessel both above and below the point of injury. If the former is done, the blood supply is restored to the limb and gangrene will not result, especially in the absence of infection. If ligation is employed, which is the classical method in military surgery, and heretofore in civil practice, the preservation of the limb depends upon the establishment of the collateral circulation, and the success of this depends partly on the location of the injury, as well as upon the immediate attendant conditions, general as well as local. In the majority of cases, the result will be favorable. If infection and gangrene occur in these injuries, the limb distal to the injury will probably be lost. If partial or localized gangrene only occurs, it is still possible to save the limb by suture of the vessels or reversal of the circulation. If neither suture of the vessel nor ligation is employed, secondary hæmorrhage becomes a menace of such momentous importance and danger as to threaten the rest and conscience of the surgeon, for it will come with the suddenness and force of an explosion. Infection increases the probability and danger of secondary hæmorrhage. In the absence of infection especially, the patient should have the benefit of the same conservative treatment as in the primary. If infection exists in the absence of gangrene, ligation is probably the operation of choice; but if the primary injury and hæmorrhage are treated in accordance with the principles and technique of modern surgery, secondary hæmorrhage will be rare, consequently will not so frequently, as now, demand the consideration of the surgeon. If both artery and vein are injured, the difficulties and dangers are greater, just as it is when both are involved in aneurism.

In thrombus, with partial or threatened gangrene, reversal of the circulation is promising of better results, and the lateral arteriovenous anastomosis of Burnheim seems to possess advantages over the end-to-end anastomosis of Carrel.

In this paper, it is not my purpose to more than allude to the concealed, or intra-abdominal, hæmorrhage from bullet or stab wounds, nor from the impact of heavy, or falling, bodies on the abdomen. In these injuries there is not only frequent and dangerous hæmorrhage, but the added danger of extravasation of the visceral contents. Such

[1] Lexer, p. 537.

[2] Lexer, p. 555.

[3] Lexer, p. 489.

[4] Chaumel and Minier. Stevenson. Wounds in War.

[5] There is a good bibliographical chapter in Binnie's Operative Surgery.

injuries are almost uniformly mortal within forty-eight hours, in the absence of prompt operation; nor in view of the location of the injury is it safe to defer an exploratory operation long, in the presence of persistent shock, for the latter indicates continuous hæmorrhage or extravasation, or both. But it is to be remembered that when profound anæsthesia and the trauma of operation are added to the existing shock, we have made a favorable result not only much more difficult, but often impossible. Under the conditions of such injuries, it is better and wiser as a rule not to employ general anæsthesia at all, though full consideration should be given to nitrous oxide and oxygen in preference to others.

Local anæsthesia may be used to advantage in many such cases, and it should appeal to the surgical judgment in the shock and prostration from primary or secondary hæmorrhage.

It sounds the recall of a fundamental principle to protest against its frequent violation in shock and first aid to the injured; and to protest the needless sacrifice, the greater because of the silence of so many teachers and leaders of opinion.

"Shock is exhaustion of the nerve-centers." (Crile.)

"Shock is inhibition of the activities of the nerve centers." (Meltzer.)

"Shock is loss of vasomotor control, due to hæmorrhage and to afferent peripheral impulses, such as trauma to the visceral peritoneum." (Janeway.)

"Shock is due to a reduction of the dioxide blood-content, and to impaired vascular tonus." (Henderson.)

Regardless of the cause and the definition, it is always a serious condition, and a problem of important significance to the surgeon.

CONCLUSIONS

We reaffirm the conclusion that general anæsthesia and operation in grave shock from injury and hæmorrhage is indefensible; that the first effect of shock from hæmorrhage is conservative, in promoting the rapid formation of thrombus and arresting bleeding, probably from impaired nerve and vascular tonus in reducing blood pressure, and depressing the action of the heart; that reaction should be awaited and the interval used in promoting it by well-known methods.

If reaction should *not* occur in a reasonable time, depending on, or influenced by, the nature of the accident and the previous state of the patient, ether and the trauma of operation would only aggravate the condition and render recovery still more doubtful. If, with reaction, the damaged vessel is not operated on, it will be wise not to stimulate the heart prematurely but rather keep it mildly subdued in order to give sufficient time for the thorough organization of the thrombus, as, without suture or ligation, it is the chief obstacle to secondary hæmorrhage. When reaction is assured, the damaged vessel—such as axillary or brachial, the popliteal, or the femoral—should, under local or general anæsthesia, be preferably sutured, secondly ligated, without needless delay. With successful suturing of the vessels, nutrition of the parts is preserved and gangrene prevented. With ligation, the collateral circulation will, in a large proportion of cases, preserve the nutrition and integrity of the parts; but it is more uncertain than suture, but more reliable than other measures.

Amputation has no place in modern civil practice as a remedy for traumatic hæmorrhage, and a smaller place in the military surgery of the future among civilized nations than in wars even of the recent past.

SURGICAL REPAIR OF BLOOD-VESSELS: ITS TECHNIQUE, ITS USES, AND LIMITATIONS[1]

By J. SHELTON HORSLEY, M. D., Richmond, Virginia

SUTURING blood-vessels was first put on a satisfactory basis by Carrel, who established the principle that successful suturing depends upon the approximation of intima to intima with a minimum amount of injury. The chief difficulty to overcome is occlusion by clotting, and improvements in technique are intended to prevent an excessive amount of clotting. The physiology of thrombus formation is still rather vague, as it is impossible to isolate chemically some of the substances that are involved in this process, and their presence has to be taken for granted in order to support a reasonable hypothesis. There are certain general reactions, however, that all physiologists agree to. The direct formation of a thrombus is due to the action of fibrin ferment on fibrinogen. Fibrinogen exists normally in blood plasma. Fibrin ferment is built up from various substances and is probably formed from the action of a thrombo-plastic substance, called by some thrombokinase, upon thrombogen in the presence of a solution of calcium salts. Thrombokinase is not a true kinase in the sense of acting solely as a ferment, for it is used up in the process of clotting. Thrombokinase is the key to the situation, and whether it acts directly, or indirectly, as Howell claims by combining with antithrombin in the blood and thus liberating prothrombin (thrombogen), it nevertheless is essential to clotting and to a large extent regulates the quantity of thrombi formed. Thrombokinase is supposed to be present in all tissues of the body and also comes from disorganized blood-corpuscles, particularly the platelets. It seems abundant in the adventitia of blood-vessels.

The practical bearing of these facts upon blood-vessel surgery is very evident, for thrombokinase can only be liberated from injured tissue. As the amount of clotting is directly proportionate to the amount of thrombokinase, it is readily seen that any undue injury to blood-vessels by rough handling, or by drying of the endothelial cells of the intima, or by the presence of too much foreign substance in the lumen, or by chemical or bacterial injuries, will result in the liberation of so much thrombokinase that there is excessive thrombus formation and the vessel is occluded. Even the most successful suturing of blood-vessels is accompanied by some clotting, but a limited amount is essential as it serves to fill the punctures from the needle holes and to bridge over the line of contact. In successful vessel suturing, however, the injury is so slight that very little thrombokinase is released and consequently there is only a small amount of thrombus formation, just enough to plug the punctures made by the needle and not enough to occlude the lumen.

We recognize, then, as the principles for successful blood-vessel surgery that a continuous surface of vascular endothelium must line the lumen and that as little injury as possible must be done this endothelium. The importance of presenting to the lumen of the vessel a continuous surface of vascular endothelium is appreciated when we recall what has been learned in a somewhat coarser fashion by intestinal suturing. Here it is a well recognized principle, as it is in blood-vessel suturing, that the endothelial surfaces must be approximated accurately. In the case of the bowel, the endothelium is on the *outside* and it is necessary to turn *in* a small flange or shelf to secure accurate apposition of the peritoneal endothelium. In blood-vessels the endothelium is on the *inside* and it is essential to turn *out* a flange in order to approximate the endothelial lining of the blood-vessel. The usual method of suturing blood-vessels consists in first placing three guy sutures and then whipping the edges of the vessel together by an overhand stitch. This necessarily cannot approximate the

[1] Read before the Southern Surgical and Gynecological Association, Atlanta, Georgia, December, 16, 1913.

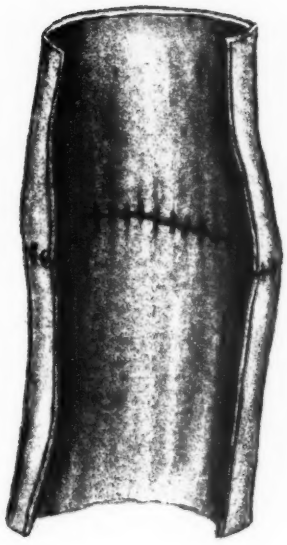


Fig. 1

Fig. 2

Fig. 3

Fig. 1. This drawing, reproduced from Guthrie, shows the appearance of the lumen of a blood-vessel immediately after it is sutured by the method of Carrel. Note the large amount of thread exposed in the lumen.

Fig. 2. This drawing, also from Guthrie, shows the appearance of the lumen of a blood-vessel several weeks after successful suturing. The stitches have been covered by endothelium which is still partly transparent. The older the specimen, the thicker and more opaque becomes the covering over the sutures until after several months the stitches are completely hidden from view. This is true of any method of suturing whether the mattress or overhand stitch is used. It is the first day or two after the suturing before the stitches are covered over that the amount of thread in the lumen is important. Sutures seem to work away from endothelial surfaces toward the lumen in case of the intestine and toward the surface in the case of blood-vessels.

Fig. 3. This drawing shows the eversion of the intima caused by the double mattress stitch and the consequent absence of any raw surface left in the lumen of the vessel. Note the very small amount of thread left exposed to the blood current as compared with Fig. 1. Note also the strong grip that the loop of the mattress stitch has on the tissue.

endothelial surface on the inside as accurately as would a mattress stitch which turns *out* a flange and compels the apposition of the intima. No one would think of suturing a bowel in a similar manner and claim that the peritoneum could be accurately brought together by merely whipping over the margins of the bowel wound as in suturing skin. If this cannot be done in intestinal surgery, the same thing holds equally in blood-vessel surgery.

The presence of foreign substances in the lumen of a blood-vessel promotes clotting. Some substances favor clotting more than others. A coating of vaseline or paraffin retards clotting. Other things being equal, however, the larger the amount of foreign substance or raw surface in the blood-vessel, the greater the likelihood of extensive clotting. A mattress suture which turns *out* a flange not only approximates the intima more accurately but leaves almost no thread exposed in the lumen; whereas the regular overhand stitch leaves a considerable amount of thread in the lumen. This is readily seen from the accompanying cut (Fig. 1) which is reproduced from Guthrie's work on blood-vessel surgery and shows the inside of the vessel soon after being sutured by the usual method. The mattress suture which is parallel to the wound also secures a better hold upon the tissues than the overhand stitch which is at right angles to the wound, and the mattress stitch is consequently less liable to cut.

(Fig. 3.) This is due to the fact that in the mattress suture the tension is more equally distributed along the whole loop of the stitch, whereas in the overhand stitch the tension is concentrated at one point; that is, at the end of the suture farthest from the wound. This fact has been brought out by Lexer[1] in the following case:

Lexer of Jena showed a case of ideal operation for aneurism and transplantation of the vessels. The patient was operated on according to the rules established by Lexer in 1907. To maintain the circulation in its normal channel, the spindle-shaped aneurism beginning above Poupart's ligament and extending below the arteria profunda was removed and the defect of the vessel repaired by the introduction of a piece of the saphenous vein, 18 cm. long. The wall of the artery markedly changed by arteriosclerosis allowed the threads of the running suture of Carrel to cut through. On the other hand, the continuous protruding mattress suture gave very good service; the thread not only held well but also prevented hæmorrhage.

Asepsis in blood-vessel suturing should be as nearly perfect as possible, just as it should be in abdominal surgery, brain surgery, or bone surgery. If the tissues around the blood-vessels are infected no suturing can be expected to be satisfactory. Yet even in the presence of infection it is not invariably a failure, as I have one successfully sutured femoral artery in a dog in which the tissues around the vessel suppurated for several weeks. As a rule, however, infection will result in failure and the proper aseptic technique should be insisted upon. Particularly should dust infection be avoided. The operator should wear a mask over his mouth and the floor of the operating room should preferably be moist. In laboratory work the floor should be flushed with water an hour or two before operating. The manner of handling tissues is most important, for gentleness is an absolute essential. No matter how careful the aseptic technique, good results cannot be secured by one who uses the same methods of handling tissue in blood-vessel surgery as would be adopted in bone surgery. The vascular endothelium should not be permitted to dry and should not be touched with any instrument.

As for instruments, I use No. 16 straight needles threaded with ooooo twisted black silk. They are threaded with silk about 14 inches long and a single knot is tied on the eye of the needle to prevent it becoming unthreaded. The short end should be cut within half an inch of the needle to avoid unnecessary loose ends dangling about. Five of these threaded needles are run through a piece of gauze of double thickness about two inches wide and as long as the thread. This gauze is then placed in a small can or ointment jar that is one-third full of white vaseline. More vaseline is put over the gauze and the jar is fastened and sterilized. The needles are not removed until they are to be used, when they are taken from the gauze, and the gauze, which is thoroughly impregnated with vaseline, is laid beneath the artery to protect it from the surrounding tissue. It is necessary to have the arterial suture staff which has been fully described in other publications. It consists of two small shafts of steel united by a spring so that the short shaft forms an angle of about 60 degrees to the long shaft. There are two buttons on the end of the short shaft, two about opposite to these on the long shaft, and one near the spring on the long shaft (Fig. 4). In order to occlude the vessel, either a rubber covered Crile clamp is used, or the ordinary serrefine, or bull dog clamp, uncovered, which has a spring so weakened that the clamp can grasp the skin of the forearm without pain. The inside of the vessel should never be seized with forceps, though sometimes it is necessary to grasp the outside. For this purpose the ordinary thumb forceps called "frog forceps" by the instrument dealers and sold for biological dissection are excellent. Several mosquito hæmostatic forceps are often needed. Aside from these special instruments, the usual instruments may be employed. The knife and scissors should be sharp.

The vessel is exposed, keeping the tissues as dry as possible. A serrefine is placed on the portion of the vessel nearest the heart, and the vessel is then gently grasped between the thumb and finger and stripped of blood to the other angle of the wound, where another serrefine is placed. This leaves the artery dry and flat like a ribbon. The vase-

[1] J. Am. M. Ass., 1913, May 10th, 1474.

Fig. 4

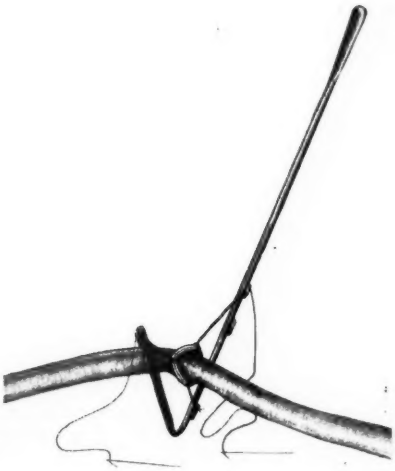


Fig. 5

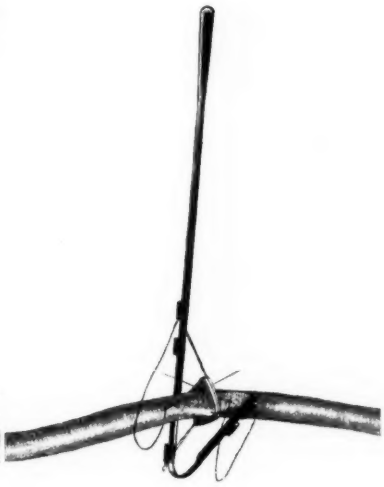


Fig. 6

Fig. 4. The arterial suture staff. For description see text.

Fig. 5. The three guy sutures have been placed and fastened to the buttons on the staff. The threaded ends from the last two sutures are left long for further suturing. The circumference of the vessel is made triangular and the intima is everted by the tension of the spring of the suture staff.

Fig. 6. The handle of the staff is upright and the whole instrument is lifted up somewhat to increase the eversion of the intima. The continuous double mattress, or cobbler's stitch, has been started using the threaded ends from the last two guy sutures. The needles are thrust through the margins of the artery near the insertion of the second guy suture. The needles should be inserted at about right angles to each other so they can be handled better. The suturing in this third is done toward the operator, that is, from the second to the third guy suture.

linized gauze from which the needles have been removed is now placed beneath the vessel, after stopping all bleeding in the wound, and the artery divided with one stroke of sharp scissors. The fingers are wiped free of blood and moisture on a dry towel and the left finger and thumb grasp one of the ends of the artery rather firmly and pull the adventitia over its cut end. The adventitia is cut off on a level with the rest of the artery. It then retracts, leaving the middle and inner coats exposed. Any remaining clots in the vessel are stripped out with the thumb and finger and the end is held firmly between the thumb and finger of the left hand and sponged with dry gauze. As the artery is collapsed and its end held between the finger and thumb the gauze cannot touch the intima but merely wipes the wounded portion and so removes any excess of thrombokinase. The tip of a finger of the right hand is then dipped in white vaseline and the end of the artery is smeared over with vaseline immediately after being sponged. This serves to keep back any further juices from the severed artery and also prevents drying of the intima. The other end of the vessel is treated in the same manner. All of these manipulations are done rapidly for it is essential to complete the suturing as quickly as possible after the intima has been exposed. One of the sutures which has been prepared as directed is inserted from without inward at one end of the artery and from within outward at the other end. No more of the vessel wall should be grasped than is necessary to secure a fairly good hold. An artery is quite tough and a small bite will be sufficient. If too much is taken, the intima cannot be properly everted. The first loop of a knot is tied, bringing the ends of the vessel together. The second loop of the knot

Fig. 7. The handle of the staff is depressed until it is horizontal and points away from the operator. The whole instrument is shoved toward the operator so as to increase the eversion of the intima in the second third. The suturing is continued as a cobbler's stitch.

Fig. 8. The handle of the staff is then brought over to a horizontal position pointing toward the operator. The instrument is lifted up so as to increase the eversion of the last third. The suturing is continued toward the second guy suture.

is tied while holding the ends of the suture taut, running the knot down in this manner so as to prevent the first loop from slipping. After tying this suture, the arterial suture staff is placed under the artery with the short shaft pointing toward the operator. The guy suture is fastened by wrapping it two or three times around the lowest button on the long shaft. The length of the suture from the button to the vessel should be about half an inch. The second suture is placed about one-third of the way around the circumference of the vessel and should be on the side away from the operator. The suture staff can be laid flat so that the short shaft is not in the way and the vessel ends can rest upon the long shaft, thus making it easier to insert the second suture. The second suture is inserted and tied in a manner similar to the first and is wrapped around one of the upper buttons on the long shaft. The threaded end is left long for future suturing, but the other end is cut close to the button. As two guy sutures are now fixed to the long shaft, the third one is easily inserted by raising up the long shaft when the point of insertion of the third suture is indicated by the retraction of the margins of the artery. The needle is inserted at the apex of the retracted margin. After this suture is tied, the short shaft is slightly compressed toward the long shaft and this guy suture is wrapped around one of the buttons on the end of the short shaft. The threaded end is left long and the unthreaded end is cut close, as in the second suture. It is important to have no unnecessary ends hanging loose. The short shaft is released and the spring makes tension on the margins of the artery, converting its circumference into a triangle, and everting the intima (Fig. 5).

The three guy sutures are inserted in the same way when an artery is united to a vein of much larger caliber, as when a divided artery is united. Sometimes it is a little more difficult when a small artery is united to a large vein, but after the guy sutures are once inserted, the rest of the procedure is identical whether vessels of equal or unequal caliber are to be united. We now have two needles from the guy sutures last inserted. A needle is taken in each hand and thrust through both margins of the artery in the region where the second suture was tied. The threaded needle from the third guy suture at the end of the short shaft will, of course, carry a little loop of thread which is of no consequence. The instrument is lifted up so as to elevate the upper third of the wound and increase the eversion. The suture is then applied in the manner of the double mattress, or cobbler's stitch, going from the second guy suture to the third (Fig. 6). At the angles particular care should be taken to go

beneath the insertion of the guy sutures; otherwise, the tension of the guy sutures may produce a wound in the endothelium which would be exposed to the lumen of the vessel. After the first third has been sutured, the handle of the instrument is depressed away from the operator and the instrument *shoved toward the operator* so as to increase the eversion of this third of the margin of the vessel (Fig. 7). The suturing is continued as a cobbler's stitch. When the second third is finished, the instrument is brought to its original position and each needle carried under the vessel so as to be ready for suturing the last third. The handle is then depressed *toward* the operator and held in such a manner as to lift up the last third and so increase its eversion (Fig. 8). The suturing is continued through the last third and when this is finished the instrument is again brought back to its original position and the suturing carried about two stitches beyond the point of commencement, where the threads are tied to each other. Each stitch must be drawn snugly when it is placed, else the intima will not be securely approximated and there will be leakage. In the carotid of a medium sized dog about five stitches are put in each third of the artery.

Sometimes, particularly in old dogs, retraction of the ends of the artery is marked and the sutures cannot be properly placed as they will tend to cut out or break under the tension. If the adventitia of the vessel is grasped with curved mosquito forceps about one and one-half inches from the severed ends, the two ends of the vessel can be shoved together by an assistant without tension on the sutures and without his hands being in the way of the operator. This is better than trying to approximate the ends by the serrefine clamps which may either come off or loosen and flood the vessel with blood. After the suturing has been completed, the short shaft is slightly compressed toward the main shaft so as to relax the tension on the guy sutures and the *distal* clamp on the vessel is slowly released (Fig. 9). If there is marked spurting at any point an extra suture should be placed there. With a little experience spurting rarely occurs, though there is usually oozing of a few drops of blood. The guy sutures are then cut and the instrument is removed. The sutured vessel is very gently compressed with dry gauze and the distal clamp is entirely removed. After about a minute the proximal clamp is slowly removed. In this time the needle holes should be plugged with fibrin and there should be no leakage. The vessel must not be returned to its bed until leakage has ceased. The whole procedure of suturing the vessel, from the insertion of the guy sutures to the last stitch, can easily be done in from ten to fifteen minutes and often in less time. Any competent surgeon who tries this technique experimentally a few times can master it.

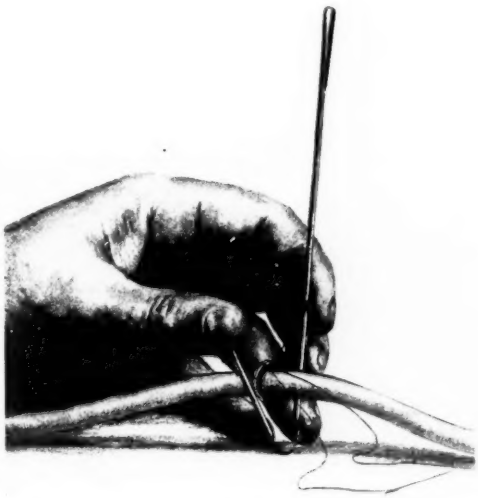


Fig. 9. The handle of the instrument is brought to a vertical position and the threads tied. The distal serrefine is slightly relaxed while the short shaft is pressed toward the long shaft so relaxing the tension of the spring. If any markedly spurting point is seen, an extra suture can be inserted.

This technique has been mentioned in three previous articles.[1] The arterial suture staff has not been altered and the general principle of approximating the intima has always been adhered to. However, a great many details of applying this principle have been changed, and I think these changes add to the

[1] Ann. Surg., Phila., 1912, February; J. Am. M. Ass., 1912, July 6, 4, and December 14, 1912, 2149.

Fig. 10. Showing the method of suturing applied to transfusion of blood. On the right is a vein which is somewhat larger than the artery. The vein has a branch through which a smooth probe covered with vaseline can be inserted and carried up into the artery if obstruction occurs. By pressing on the main trunk of the vein clots are blown out through the branch.

efficiency of the technique. The suture staff, which holds the vessels so that the edges are everted and each stitch is inserted under the *same tension* from the first to the last, greatly facilitates the suturing and makes possible the carrying out of the principles that have already been noted.

The changes from the other publications are as follows:

1. A double mattress or cobbler's stitch is now used instead of the single mattress stitch as originally advised. It was found that when the single mattress stitch was used there were points between sutures with but little compression and no raw surface. This sometimes made a small amount of leakage that was difficult to control; also a little diverticulum would be formed that was

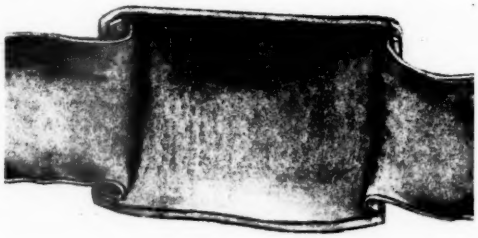


Fig. 11. Showing a piece of rubber tube sutured in between the cut ends of an artery. Note the complete absence of any sharp margin of the tube and the absence of thread in the lumen. This cannot be done by the regular overhand suture.

a weak spot and would occasionally result in secondary hæmorrhage. The double mattress stitch does away with these objections and approximates the intima firmly as by a fine clamp around the entire margins of the vessel and at the same time exposes no more thread in the lumen than is exposed by the single mattress stitch. The use of this stitch can be readily acquired by any one who tries it. It has been most successfully used in intestinal suturing by Crile, and is much more needed in vessel suturing, as there is more pressure in a blood-vessel than in the bowel.

2. No salt solution is now used to wash out the vessels. It has been the object of this technique to eliminate as far as possible every procedure that is not essential to success. Washing out the ends of the vessel with salt solution not only adds somewhat to the trauma of the endothelium, makes a sloppy wound, and prolongs the procedure, but according to Guthrie, rather tends to increase clotting than diminish it.

3. In order to strengthen the second and third guy sutures, both ends of these sutures are now wrapped around the buttons, instead of merely using the unthreaded ends, as was formerly advised. Instead of first inserting the guy sutures and then placing them on the suture staff, it is better to fix them on the staff as they are inserted. This not only relieves the necessity of handling the sutures twice, when once will do, but it is much easier to place the second and third sutures when the first has been fastened to the staff, as the

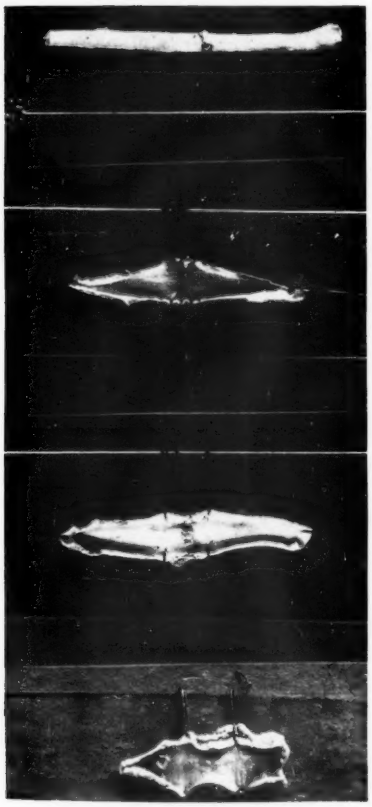


Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 12. Photograph of an iliac artery of a dog which was removed a few minutes after suturing after the blood had been turned on and no leakage appeared. Note the eversion of the intima constituting a flange without diminution of the caliber.

Fig. 13. Photograph of the lumen of carotid artery of a medium sized dog. The blood had been allowed to flow for a few minutes and there was no leakage. Note the absence of thread in the lumen.

Fig. 14. Photograph of a carotid artery 11 days after being sutured. The lumen is smooth. The stitches have stretched and are visible beneath the transparent coating of endothelium.

Fig. 15. Photograph of a femoral artery 33 days after operation. The stitches are barely visible. A small black speck in the upper edge shows the line of sutures. The covering over the stitches is thicker than it usually is in this time, but the specimen illustrates, as compared with previous figure, how stitches are gradually buried.

Fig. 16. Photograph showing external appearance of a section of external jugular vein which was sutured in between the divided ends of a carotid. The specimen was removed 24 hours after operation. It is collapsed and free from clots.

Fig. 17. Photograph of a segment of external jugular vein which was sutured in the place of a resected portion of the right carotid of a large dog. Note the valves about the middle of the specimen in one of which is a small clot. The specimen was dilated at this point probably from the force of the blood stream in overcoming the valves. Otherwise the intima is perfectly smooth and the sutures are mostly buried from view. The specimen was removed 63 days after operation.

Fig. 18. Photograph of specimen of reversal of circulation in the neck. The proximal end of the carotid was sutured to the distal end of the external jugular vein in a medium sized dog. This specimen was removed after 39 days. The sutures are distinctly buried, though the endothelium over them is still transparent at places. The line of suturing is perfectly smooth. A short distance from the line of sutures are the crumpled up valves which were forced and broken down by the blood stream.

staff can then be manipulated so as to bring the margins of the vessel wound into a more advantageous position for suturing.

Sensational newspaper articles have done blood-vessel surgery much harm. The idea that a new limb can be grafted on and will remain useful, or that a kidney or thyroid can be beneficially transplanted from one individual to another is entirely erroneous. None of these experiments, even in animals, has been permanently successful. A kidney transplanted from one dog to another will probably functionate for a while, but sooner or later the fine differences of serum and tissue destroy the organ and prevent permanent

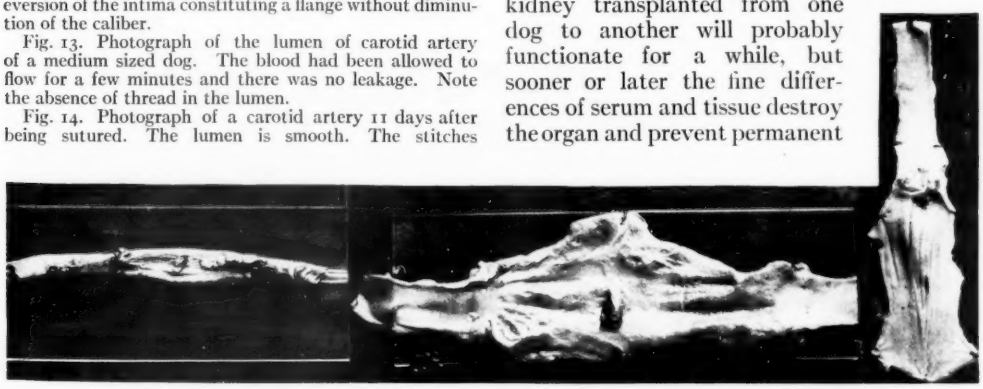


Fig. 16 Fig. 17 Fig. 18

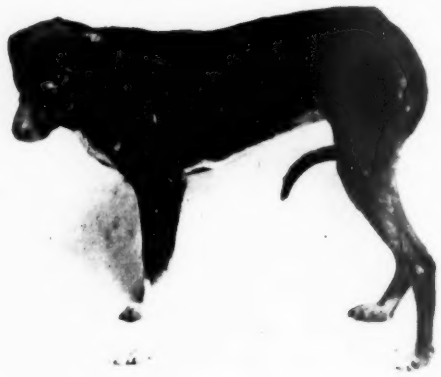


Fig. 19. Photograph of a dog in which a portion of the abdominal aorta was resected and a section of rubber tubing coated with paraffin and vaseline was sutured in to fill the defect. The dog made a perfect recovery. The photograph was taken six months after operation. The dog was killed and the specimen which was removed showed the tube completely encapsulated but occluded. The occlusion had evidently been gradual, as there were no bad symptoms and no paralysis of the legs. A gradual occlusion in such cases which will permit of time for collateral circulation is clinically as satisfactory as if the tube remained permanently open.

success. To quote from the preface to Guthrie's monograph on blood-vessel surgery: "Heterografts succeed at first, but inevitably fail after the first few weeks. This is the disappointing but unanimous conclusion of the experimenters. Thus there is, at present, no temptation for the enthusiastic surgeon to try and graft one lobe of the thyroid or a kidney taken from a healthy donor. The poor man will not be tempted to exchange one of his sound kidneys for so much hard cash."

However, blood-vessel surgery has a very broad field, for while complicated glandular organs do not survive transplantation, a simpler tissue does. A blood-vessel, for instance, can be transplanted from one animal to another and may functionate indefinitely. The four fruitful fields of blood-vessel surgery at present are:

1. Wounded blood-vessels. Here direct suture can be used, or if much of the vessel has been injured, a segment of some vein from the patient's own body, as the saphenous can be sutured in the defect.

2. In excision of malignant tumors which have been heretofore considered inoperable because of involvement of a large blood-vessel, a section of the vessel can be removed and the vessel repaired as for trauma.

3. Aneurisms may possibly be treated in a similar way, though on account of the diseased condition of the vessel wall it is not likely to be so satisfactory as in surgery following trauma. However, several successful cases have been reported, as the case of Lexer referred to above.

4. Transfusion of blood. There are a great many ways of performing transfusion of blood, but probably no method can be quite so ideal as that which permits the flow of the oxygenated arterial blood of the donor directly over an endothelial surface into the veins of the patients. While numerous instruments have been devised for drawing blood from the donor into a receptacle and then injecting it, even in the short space of time when the blood is not in contact with endothelial surfaces there may be some changes that will render it less valuable. Certainly, it is better to have it directly transferred to the venous system of the patient. The various tubes and canulas are often of great service, but if they do not work, the whole operation will have to be done over again.

In the method of suturing just described, when applied to transfusion, a vein should be selected sufficiently large and with a nearby branch (Fig. 10). If for any reason an obstruction occurs at the suture line, the finger can be placed on the main trunk of the vein, and the sutured area gently manipulated between the thumb and finger, when the clot will usually be blown out of the venous branch. If this is not successful and especially if the radial artery from which the blood is taken contracts too greatly, a smooth probe covered with vaseline can be introduced through the venous branch, and carried up through the sutured region into the radial artery. When the probe is withdrawn a full flow of blood follows. It is impossible to do this if a canula has been used. After a probe has been once introduced in this manner, clotting occurs in from five to ten minutes,

but a free flow of blood for twenty minutes is all that is necessary in most cases, and it is better to do this simple procedure two or three times than to perform the whole operation over again. If for any reason the suturing does have to be done again, a small section including the sutures can be removed and will leave enough of the artery and vein to bring together again; whereas, with a canula so much of the artery and vein is tied off that enough will hardly be left for another operation.

The photographs of specimens show some of the work that has been done by this method. A rubber tube has also been sutured in after resection of an artery (Fig. 11). These experiments have not yet been completed and a report will be made later upon this feature. However, I do not believe a rubber tube can be sutured satisfactorily into the defect caused by resection of an artery by the overhand method, as the tube will leave sharp edges of the rubber exposed to the blood-current, whereas the mattress stitch prevents this by everting the edges of both the tube and the artery.

CANCER OF THE BREAST IN A BOY FIFTEEN YEARS OLD[1]

By ROBERT C. BRYAN, M. D., Richmond, Virginia

ONE per cent of all tumors of the breast occur in the male and two per cent of this number are malignant. Poirier, Schuchardt, and Warfield have collected from literature something like 509 cases of carcinoma in the male mammary gland. The age for this condition is apparently a little later in the male than in the female, about 60 years. Trauma is responsible in 13 per cent of female mammary carcinoma and in 50 per cent of the male. Theoretically, the right should be involved more often. Both the right and the left breasts, however, are apparently affected with the same degree of frequency, despite occupation as instanced in shoemakers, engineers, etc.

	Males	Females
Total number cases	90	500
20 to 25 years	2	0.6
25 to 30 years	2	4
30 to 35 years	9	6
35 to 40 years	12	14
40 to 45 years	11	16
45 to 50 years	17	20
50 to 55 years	15	15
55 to 60 years	12	10
60 to 65 years	7	9
65 to 70 years	3	3.2
Over 70 years	10	2.2
Mean age	50	48
Earliest age	20	22
Latest age	82	84

It will be seen from this table that the average age at which the disease originates in males is two years later than in females.

It is further noticeable that a relatively large number of the male cases begin after 70 years of age. In most other respects there is remarkable similarity as to the age distribution in the two sexes.[2]

The two greatest extremes in age of cancer of the breast that the writer can find in literature are the following:

Lunn's Case: A man aged 91 years, shoemaker, admitted into Marylebone Infirmary May 22, 1896. Pain in left breast ten months before admission, due possibly to friction of braces. Small scab formed around the nipple. Three months before admission lump in the left axilla. Fungating growth involving nipple and one inch of area. Breast and glands removed. Wound healed by first intention. Death from hypostatic congestion of the lungs a few days after operation. No post-mortem allowed. There were also secondary glandular deposits, rare in cases of duct carcinoma.[3]

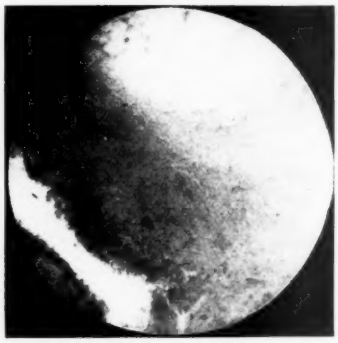
Blodgett[4] reports that his attention was called to a boy, 12 years of age, who was born of healthy parents and in whom no suspicion of malignant heredity could be found. Up to the age of 12 years this boy presented no indication of glandular or other disease. Soon after this time swelling was

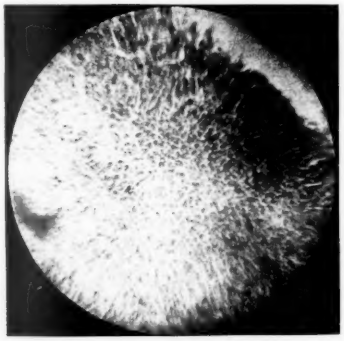
[1] Read before the Southern Surgical and Gynecological Association, Atlanta, December 16, 1913.

[2] Williams, W. R. Cancer of the male breast based on the records of 100 cases, with remarks. Lancet, Lond., 1889, ii, 261.

[3] Lunn, J. R.: Case of cancer of the breast in man aged 91 years. Tr. Pathol. Soc. Lond., 1897, viii, 247.

[4] Blodgett, A. M. Boston M. & S. J., 1897, cxxxvi, 611.





noticed in the left breast, beneath and attached to the nipple, which was slightly reddened and harder than its fellow of the opposite side. The growth on microscopic examination presented the typical structure of carcinoma, and had invaded all visible glandular tissue of the breast. The wound healed by first intention and there has been no indication of recurrence or metastasis since the operation was performed five years ago.

The case which the writer wishes to present is that of A. C., age 14 years, 8 months, operated on February 6, 1913. In August, six months before operation, the boy, while playing golf, was struck a violent blow on the right breast at about the nipple by a golf ball in flight, which left its impress and made him quite sore for several days. He soon got over the soreness, paid no further attention to it, but five months later, in January, while bathing, noticed a little lump under and very close to the right nipple. It was not painful, but recalling the blow he received, his family decided to have the tumor investigated. On examination the boy was found to be an exceedingly well developed specimen, 5 feet 2 inches, weighing 116 pounds, erect in figure and enjoying the best of health. The family history is negative throughout; heart and lungs negative. Urinalysis negative, and the blood count of no peculiar interest. A small, round, hard tumor, about the size of the smallest cherry stone, was found in the lower right quadrant about one-eighth of an inch from the nipple, freely movable under the skin and on the underlying fascia.

The nipple was the same as on the left side; there was no retraction nor dimpling. The skin over the tumor showed nothing unusual and the most careful investigation of the glands in the axilla and about the clavicle and the inguinal region gave no evidence of their enlargement. In the last week the growth had been handled and palpated considerably and consequently was a little tender.

Under general anæsthesia a semicircular incision was made under the breast, the flap dissected back, the tumor and surrounding fascia were removed down to the pectoral muscle, and the wound brought together without drainage, the patient leaving the hospital in three days. A report by Dr. S. B. Moon, pathologist to Grace Hospital, states that "the specimen, 1014, is adenofibroma with distinct scirrhous carcinoma in scattered areas of rather active cell proliferation."

The anatomical and pathological differences between the male and female breast are in degree rather than in kind:

Both develop normally until the beginning of the second decade when the female breast begins to take on its complex functions and duties, the male to be arrested in growth.

Occasionally there are embryological dislodgments of subepidermal nodules which may extend into the region of the male breast, histologically impossible to differentiate from carcinoma, yet they are not cancer. The bean-like submucous nodules found now and then in the appendix belong to this group. They are unquestionably of congenital origin. Aschoff calls them submucous nævi. In the report of Mayo's clinics by McCarty, these nodules are called carcinoma of the appendix and have been observed, according to McCarty, from a boy of nine to a man of eighty years of age.

The diagnosis must be made along identically the same lines as in the female. The same morbid rules obtain. It would appear that tumors of the male breast should be recognized earlier than in the female; small growths are more easily noticed, as they are not surrounded by so much breast tissue. In the later stages, pain, retraction, ulceration, and metastasis conform to the anatomic principles of the female. The prognosis and mortality then should be better for carcinoma of the male breast than in the female.

EVENTRATION OF THE DIAPHRAGM[1]

With the Report of a Typical Case with X-Ray Diagnosis

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THE condition known as eventration of the diaphragm is not really a diaphragmatic hernia, but a diffuse relaxation of half of the diaphragm, simulating a hernia. Griffin (1) suggests "elevation of the diaphragm" as a better name. It is generally considered a congenital condition, the left half usually being involved. The diaphragm loses its muscular quality and becomes a fibrous membrane with atrophy and fatty deposit. The degree of eventration varies greatly, and may reach the level of the second rib.

The exact cause of the condition is unknown. Baetge (2) acknowledges that it is a developmental anomaly. Vogel (3) holds that it is due to congenital predisposition, with degenerative changes in the muscular fibers. Motzfeldt (4) has found atrophy of the phrenic nerve on that side, and offers three hypotheses: (1) Primary aplasia of the musculature, with secondary atrophy and degeneration of the phrenic nerve; (2) primary aplasia and atrophy of the phrenic nerve, with secondary muscle degeneration; (3) both together. Trauma has been offered as a cause in only one case — that reported by Reuss (5), in which a man 46 years old, who was always accustomed to hard work, sustained a fall, after which he suffered marked palpitation and cyanosis, with displacement of the heart to the right. The X-ray revealed the diaphragm on the left side at the level of the third rib.

This condition may exist for some time without symptoms, as evidenced by the fact that the majority of cases reported were adults. In all marked cases dyspnœa, cyanosis, and palpitation are present on the slightest exertion, due to the pressure of the abdominal organs on the heart and lungs; also difficulty is encountered in lying upon the healthy side. Pain is an inconstant symptom; constipation is usual, and dysphagia paradoxa and hæmatemesis are occasional. Upon examination the abdomen is often found retracted, with the chest flaring below, with an increase in size of the affected side. In children, there may be respiratory protrusion between the ribs. The heart usually is displaced to the right — markedly so in the cases recently reported. Over the affected side the chest is tympanitic, with gurgling sounds and absence of breath sounds.

The diagnosis is very difficult, even in the most extreme cases, without the aid of the X-ray. With the fluoroscope the paradoxical respiratory phenomenon may be demonstrated, and the röntgenogram usually portrays the remains of the diaphragm as a fine line above the visceral mass. With bismuth in the stomach or colon, the X-ray diagnosis is made certain. Griffin holds that the appearance of bismuth in the colon above the bow-like line of the chest is conclusive evidence of diaphragmatic elevation or hernia.

In the differential diagnosis it is most difficult to distinguish between eventration and a hernia through a large congenital defect. Other conditions to be considered are pneumothorax, especially when associated with dextrocardia, subphrenic abscess, pyopneumothorax, and œsophageal diverticulum. Cohn (6) reports one case which had been diagnosed cardiospasm by competent clinicians in which the X-ray revealed an eventration of the diaphragm. Motzfeldt's case, a woman 41 years old, had previously been reported by Höst in 1911 as a case of dextrocardia, and at autopsy the diaphragm on the left side was found at the level of the second interspace, although its insertion in the thorax was normal.

At post-mortem it may be found that any or all of the abdominal organs may be in the chest. The heart is usually displaced to the right and often enlarged, and the

[1] Read before the Chicago Medical Society, November 14, 1913.

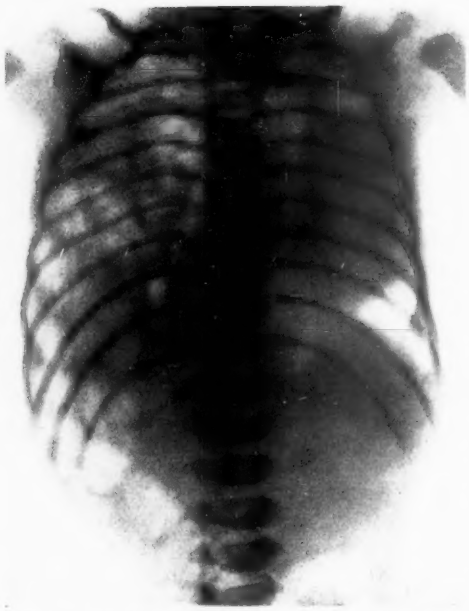

Fig. 1. Röntgenogram taken on fourth day of life. Apparent absence of diaphragm on the left side with bowel shadows in the chest. Retraction of abdomen.

lungs compressed. Other congenital anomalies occasionally are found, as in the case reported below, in which the testicles were found undescended. Only one case of right-sided eventration was found in the literature (7).

The name eventratio diaphragmatica was given by Petit in 1790. The condition was noticed as early as 1783 by Pyl, and a typical case reported by Frariep in 1857, occurring in a 19-year-old girl. Petit first differentiated it from the usual diaphragmatic hernia. The latter is a surgical condition, while eventration of the diaphragm is not.

According to Vogel and Giffin, there are about twenty cases reported up to 1912. Motzfeldt, however, only recognizes those in which the diaphragm is described as a fibrous structure and not merely elevated. He collected eleven cases up to 1913, and reported one more. Subsequent to his article, I have been able to collect six cases reported as eventration of the diaphragm by Baetge (2), Haase (8), Reuss (5), and Kayser (9), in all of which (still living when reported) X-ray diagnosis was made. Whether Scheidemandel's (10) two cases are included in Motzfeldt's report I do not know, as his bibliography is not complete.

I wish to report another case of congenital eventration of the diaphragm in which the X-ray diagnosis was made a few days after birth.

Baby G. was born in the maternity department of the Michael Reese Hospital in the service of Dr. Ludwig Simon on June 14, 1913. The mother was a Russian, aged 33, a II-para, whose first child was healthy and normal. A Wassermann test made on the mother was negative. The child was born with a "caul" and with the cord wrapped once about the neck; otherwise labor and delivery were normal. At birth a marked asphyxia livida was present, and no effort at respiration was made until artificial measures (Byrd's method of resuscitation and warm tubbing) were employed for twenty minutes. Cyanosis did not then entirely disappear, and the pulse and respiration were very rapid. Examination at this time revealed a dextrocardia, scaphoid belly, and undescended testes. As soon as respiration was established the child was put into the stork-tub, external

Fig. 2. Röntgenogram taken three and six hours after ingestion of bismuth. Stomach and bowel in chest.

heat was applied, and breast milk dr. 1 given every two hours with a medicine dropper. The birth weight was 3310 gms.

June 16: Great difficulty was encountered in nursing, with marked cyanosis and convulsive movements when at the breast. The infant was taken from the breast and given mother's milk by bottle.

June 17: Respirations continued very rapid, and spells of very marked cyanosis occurred. Maximum temperature was 101°. Weight 3100 gms. Physical examination revealed the left chest tympanitic, the whole abdomen dull, and the edge of the liver not palpable. The belly was markedly retracted. The bow-line of the chest was flaring. Gurgling sounds were heard in the left chest, and breath sounds were heard only in the right chest posteriorly. The heart beat was rapid, but the tones were clear.

June 18: the fourth day of life: The general condition was improved; feeding retained, and there was no vomiting. A röntgenogram (Fig. 1) taken by Dr. Frances Turley revealed the heart in the right chest and liver on the right side. There was an apparent absence of the diaphragm on the left side, with the bowel shadows in the chest. The infant was placed on its left side with the head somewhat elevated, to relieve as much as possible the pressure on the thoracic viscera. The feedings were increased to breast milk 1 oz. every two hours.

Fig. 3. Röntgenogram taken immediately after ingestion of bismuth. Demonstrating stomach high in chest.

Fig. 4. Röntgenogram taken soon after death with bismuth in the bronchi. Only lower lobe of right lung admitted the bismuth emulsion. The gas distention of the stomach and bowels here beautifully portrays the extent of eventration.

June 19: The general condition was good. Cyanosis was less marked. Weight 3140 gms. An attempt to give a bismuth and starch enema for an X-ray picture of the colon failed.

June 21: Weight 3150 gms. Temp. 97.4°. Feedings were increased to 2 oz. every three hours. Bismuth subcarbonate was given in the early morning feedings, and a röntgenogram (Fig. 2) was taken three and six hours after ingestion. Another feeding was then given and a second picture (Fig. 3) immediately taken. As seen on the accompanying röntgenograms, the stomach and part of the small and large intestine were found high in the left chest, and the heart pushed to the right.

June 23: A spell of deep cyanosis was noted after attempt at nursing again. The protocol recorded that the cord was off and the navel was in good condition. Temperature 98.6°, respirations 120. Weight 3100 gms.

June 28: A crying spell with marked cyanosis was again noted. Temperature 101°, respirations 110. Weight 3135 gms.

July 1: The general condition was improved; the cyanosis was less marked, and the infant nursed at the breast with little difficulty. Weight 3215 gms. Temperature 98°, respirations 96.

July 9: The course for the past week has been

Fig. 5. Photograph showing the relations of the eventration in the thorax.

uneventful, but to-day a severe crying spell occurred, with very deep cyanosis, so that the child's condition looked desperate. Stimulation gave some relief. The mother was discharged from the hospital, and the infant transferred to the Sarah Morris Hospital. The weight was 3305 gms., only 5 gm. below the birth weight. Admitted to the Sarah Morris Hospital in the medical service of Dr. Ernest Lackner. Soon after admission another severe crying spell occurred, with marked cyanosis. Dysphagia was also noted. Temperature 96.6°, pulse 160, respirations 44. The cyanosis cleared somewhat, and breast milk oz. 3 was taken in the evening. The infant passed a fair night, but appeared very weak in the morning.

July 10; the twenty-sixth day of life: At 2 P.M. the child suddenly became very cyanotic and dyspnœic. All attempts at stimulation failed. The condition grew gradually worse in spite of all heroic measures and exitus occurred at 4.10 P.M.

An autopsy permit was obtained from the mother; before posting, however, a tracheotomy was performed, and a bismuth emulsion injected into the bronchi to determine the amount of functionating lung. The röntgenogram (Fig. 4) revealed what later was found to be the case, namely, that the lower lobe of the right lung was the only portion which contained air. This picture also gives the best view of the eventration.

The abdominal parietes were opened in the usual manner, and the anterior chest wall removed without disturbing the lower rib border, and a photograph taken (Fig. 5) before disturbing any of the relations. Examination revealed a typical eventration of the diaphragm with the stomach, the greater part of the small and large intestine, the spleen, the left lobe of the liver, the tail of the pancreas, and the upper pole of the left kidney in the chest. The heart was found greatly enlarged and pushed extremely to the right. The lungs were found above and to the right of the diaphragm, all compressed except the lower lobe of the right lung. The diaphragm on the left side was found to be a fibrous dome, thin and gray in appearance, extending to the level of the second interspace, in which no muscle fibers were seen. The remaining abnormality was that of undescended testes, which were found in the abdomen. The viscera were removed *in toto* and preserved in Kaiserling.

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COMPLICATIONS FOLLOWING SURGICAL OPERATIONS

A Report of the Complications in a Series of 6,825 Surgical Operations Performed in the Mayo Clinic in the Year 1913

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THE keeping of an accurate account from day to day of all the complications that occur following surgical operations is found to be an exceedingly valuable procedure. It allows one to sum up from month to month and year to year his failures and compare them with those of previous years. If this is not done, the small failures in surgical work are soon forgotten and the surgeon is inclined to feel that his results on the whole are better than they actually show when appearing in cold figures. It is comparable to a business firm balancing its books at the end of a period of business and is the only true way of acquiring an accurate knowledge of the results in surgical work. If there is not a marked improvement in a diminishing number of complications, one must conclude that the cases have been exceptionally unfavorable or that his technique is not improving. As was stated in a previous report, we find that this procedure has revealed many errors in technique which it has been possible for us to overcome.

In reporting the complications that occurred in the Mayo Clinic during the year 1912, it was stated that bacteriologic cultures would be made in the future from all wounds that did not heal primarily. The greater part, but not all, were subjected to bacteriologic investigation up to that time. In explanation, it should be stated that all wounds were considered as possibly infected in which there was an escape of fluid at any time during the patient's residence in the hospital. In order to secure perfect convalescence, it is believed that if the technique at the time of operation is as near perfect as our present knowledge of surgical methods allows, all wounds which are not drained should be dry at the time of leaving the operating room and should remain so until healing has occurred.

It is interesting in this connection to note that under this plan there occurred an escape of fluid from the wounds in thirty-five patients, cultures from which developed no growth. We, therefore, consider that these wounds were not infected in the ordinary sense of the word, but that irritation or a slight accumulation of blood placed so much work upon the tissues in the neighborhood of the wound that this extra fluid could not be absorbed readily and, though sterile, was finally discharged from the wound.

In last year's report, the statement was made that it appears in this clinic that most infections come from the tissues of the patients rather than from some outside source, such as suture material, dressings or instruments. In examining the bacteriologic report for 1913, this opinion seems to be verified to a marked degree since almost every organism identified is an organism which is commonly present in the body fluids or tissues and that these organisms are of the type that are readily destroyed by the methods of sterilization in common use in surgical clinics. Since we know that it is impossible to kill bacteria in the tissues of the body without destroying the vitality of these structures, and that the accessories used in the operating room, such as gloves, instruments, suture material and dressings, can readily be sterilized, it seems more reasonable to assume that the infection comes from the patient rather than that it is introduced into the patient from some outside source. We realize, however, that this cannot always be proved, but repeated bacteriologic examinations of dressings, suture material, water, etc., used in our clinic, have failed to reveal any living organisms.

The report this year includes 6,825 cases, comprising the in-patients of St. Mary's Hospital. These are the patients who had a sufficiently serious type of operation to require them to remain in the hospital during their convalescence. It does not include the

out-patients having minor operations who were allowed to leave the hospital soon after their operations.

INFECTIONS

The infections for the year 1913 were 117, or a percentage of .017 for the 6,825 cases. The various groups of operations in which infections occurred are as follows:

TABLE 1

	No. of Operations	No. of Infections
Appendectomy	1,085	31
Nephrectomy	94	7
Posterior gastro-enterostomy	299	18
Intestinal obstruction	19	1
Inguinal hernia	308	17
Ligation superior thyroid	410	4
Thyroidectomy	1,137	7
Subtotal abdominal hysterectomy	230	5
Freeing adhesions	...	1
Exploration	92	2
Total abdominal hysterectomy	79	5
Internal alexander and appendectomy	117	1
Cholecystectomy	524	2
Bullet knee	1	1
Excision abdominal scar	1	1
Popliteal aneurism	1	1
Hernia and external alexander	44	1
Ventral hernia	76	2
Pyloroplasty and appendectomy	13	1
Resection stomach	78	2
Femoral hernia	29	1
Tuberculous glands neck	60	2
Submaxillary glands	47	1
Block dissection neck	7	2
Tubes and ovaries	117	1
Total		117

Table 2 shows the number of infections occurring each month with the type of bacteria present. It is shown that more infections were present in the winter months. We believe that this is the usual rule since the skin of the average patient is not in as good condition during these months as in the other months of the year. We have always felt that an active, healthy skin was capable of taking care of a considerable amount of infection, while one that was sluggish and irritated was in a condition to favor infection.

TABLE 2

INFECTIONS OCCURRING EACH MONTH

	No growth.	B. coli.	Staph. albus.	Staph. aureus.	Staph. citreus.	Pneumococcus.	Diplococcus.	Streptococcus.	Unidentified B.	B. Subtilis.	Micro. Catarrhalis.	Not reported.	No growth.	Pure.	Mixed.	Total.
January	3	6	7	3	5	1	2	4	1	1	..	5	3	14	7	26
February	1	2	4	6	..	1	1	1	..	..	..	..	1	11	2	13
March	7	3	4	..	1	1	3	..	..	..	..	..	7	5	3	8
April	8	2	..	2	..	..	1	1	..	..	1	..	8	1	3	4
May	2	1	1	5	..	..	1	..	..	..	..	..	2	6	1	7
June	3	2	3	3	..	..	..	..	1	..	..	..	3	7	1	8
July	5	2	..	1	..	..	..	..	..	..	..	..	5	5	..	3
Aug. and Sept.	..	6	7	3	2	2	1	2	..	..	2	..	..	9	7	16
October	..	3	3	4	..	..	..	2	..	..	1	..	..	4	4	8
November	..	4	1	2	2	1	..	..	..	..	..	..	10	..	..	10
December	6	9	5	3	1	3	1	2	..	..	2	..	6	7	7	14
Total	35	40	35	31	12	9	10	12	1	2	6	5	35	77	35	117

TABLE 3

CASES HAVING A SINGLE ORGANISM

B. Coli —
- Appendectomy ... 12
- Nephrectomy ... 2
- P. Gast. and App ... 2
- Intest. Obstr ... 1
- P. Gastro-enter ... 2
- Total ... 19

Staph. albus.—
- Rt. Ing. Hernia ... 2
- Gastro and App ... 1
- Lt. Ing. Hernia ... 1
- Appendectomy ... 4
- Lig. Sup. Thy ... 2
- App. & Rt. Ing. Hern ... 1
- Nephrectomy ... 2
- Thyroidectomy ... 1
- Sub. Abd. Hyst ... 1
- Freeing adhesions ... 1
- Dbl. Ing. Hernia ... 1
- Exploration ... 1
- Total ... 18

Staph. pureus.—
- Rt. Ing. Hernia ... 3
- Lt. Ing. Hernia ... 1
- Appendectomy ... 4
- P. Gastro-ent ... 4
- Thyroidectomy ... 2
- P. Gast. & App ... 2
- Total Abd. Hyst ... 2
- Exploration ... 1
- Int. Alex. & App ... 1
- Cholecystect. & Appendectomy ... 1
- Total ... 21

Staph. citreus.—
- Bullet knee ... 1
- Appendect ... 1
- Rt. Ing. Hern ... 1
- Gast. & App ... 1
- Gastro-enter ... 1
- Exc. Abd. scar ... 1
- Pop. Aneurism ... 1
- Total ... 7

Pneumococcus —
- Append ... 1
- Hernia and Ext. Alex ... 1
- Total ... 2

Streptococcus —
- Vent. Hernia ... 1
- Rt. Ing. Hern ... 1
- Thyroidect ... 1
- Total ... 3

B. Subtil.
- Append ... 1
- Nephrect. & Append ... 1
- Total ... 2

Micro. Catar.
- Append ... 1
- Thyroidect ... 1
- Ing. Hernia ... 1
- Total ... 3

Table 4 shows the cases in which the cultures from the wounds revealed more than one organism or a mixed culture.

PULMONARY COMPLICATIONS

The total number of pulmonary complications was 87, or a percentage of .012 for the entire series. None of these were fatal. The deaths for the year will be reported elsewhere. Ether was used exclusively in the clinic as a general anæsthetic, novocaine as a local anæsthetic. The pul-

TABLE 4

CASES HAVING MORE THAN ONE ORGANISM

	Bacillus Coli.	Staph. Albus.	Staph. Citreus.	Staph. Aureus.	Pneumococcus.	Streptococcus.	B. Subtilis.	Unidentified B.	Diplococcus.	Micro. Catarrhalis.
Left hernia	1		1							
Total abdominal hysterectomy			1		1					
Double inguinal hernia		2				2				
Double inguinal hernia	1			1						
Ventral hernia		1				1				
Resection stomach		1				1				
Gastro-enterostomy and Append	1	1				1		1		
Total abdominal hysterectomy	1				1					
Gastro-enterostomy and append	1								1	
Appendectomy	1	1								
Femoral hernia	1	1								
Appendectomy				1			1			
Tuberculous glands of neck		1		1	1					
Abdominal hysterectomy		1								1
Submaxillary glands				1		1				
Appendectomy	1									1
Abdominal hysterectomy				1					1	
Posterior gastro-enterostomy				1		1				
Tuberculous glands of neck				1					1	
Abdom. hysterect. and appendect		1		1						
Hyster. ovary and tube	1				1	1				
Block neck		1	1	1					1	
Appendectomy										
Appendectomy	1			1						
Tubes and ovary	1	1				1				
Nephrectomy	1	1								
Appendectomy	1	1								
Hernia	1			1						
Resection stomach	1				1				1	1
Nephrectomy	1	1				1				
Gastro-enterostomy		1				1				
Appendectomy		1								1
Anterior gastro-enterostomy					1					1
Total abdom. hysterectomy	1	1				1				
Thyroidectomy	1	1				1				
Totals	18	19	3	11	6	13	1	1	5	5

monary complications have been classified in five groups.

Group 1. Acute post-operative congestion of the lungs. Into this group are placed those patients who disclosed acute congestion or an excess of secretion in the air passages as soon as they were returned from the operating room or within twenty-four hours thereafter. Many of these cases were patients that were on the verge of an acute cold but had not revealed sufficient symptoms prior to the operation to warn the operator against proceeding. Certain others were patients that had vomited and sucked into the air passages infectious material from the mouth and pharynx. Others were probably those that had congestion due to prolonged cooling of the air passages from a long anæsthetic. We know that an excess of secretion in the air passages is due to irritation so that we assume the excess in these cases must be due to some form of irritation.

TABLE 5

ACUTE POST-OPERATIVE CONGESTION OF LUNGS

Anterior gastro-enterostomy and appendectomy	1
Excision duodenal ulcer and cholecystectomy	1
Appendectomy	2
Resection of stomach	1
Inguinal hernia	3
Appendectomy and extra-uterine pregnancy	1
Cholecystect., appendectomy and gastro-enterostomy	1
Gastro-enterostomy and appendectomy	1
Posterior gastro-enterostomy	3
Splenectomy	1
Cholecyst-jejunostomy	1
Appendectomy and iliac kink	1
Exploration of abdomen	1
Cholecystectomy and choledochotomy	1
Colostomy and resection of colon and urin. bladder	1
Cholecystostomy and appendectomy	1
Total	21

Group 2. Pleurisy. Patients having a pain in the chest with or without a slight rise in temperature and a slight cough without expectoration are classified in this group. There is often no cough or increase in temperature but the presence of pain and a pleuritic rub on auscultation. The symptoms last from a few days to a week, rarely longer. I believe that patients operated on for pathologic conditions in the upper abdomen often have pleurisy as the result of the post-operative inflammatory reaction extending to the diaphragm and pleura.

TABLE 6

PLEURISY

Gastro-enterostomy	3
Supravaginal hysterectomy	1
Cholecystectomy	3
Resection of stomach	1
Laparotomy for pelvic inflammation and appendectomy	1
Appendectomy and Baldy-Webster	1
Currettage and Baldy-Webster	1
Appendectomy and ing. herniotomy	1
Nephrectomy	1
Vaginal hysterect. and perineorr	1
Thyroidectomy	1
Cholecystostomy and appendectomy	1
Litt. colostomy	1
Choledochotomy	1
Total	18

Group 3. Bronchitis. In this group are the patients who have an excessive secretion in the air passages. Many of them have only a slight rise in temperature for a few days and

expectorate an excessive amount of mucous or mucopurulent material. Others have a temperature of 102° to 103° F. with increased respiration but the symptoms subside quickly and the temperature drops to normal in from 48 to 72 hours, although the cough and expectoration may continue for several days longer. The physical examination discloses no areas of consolidation in the lungs. It is often difficult in these cases to differentiate between a congestion of the lungs, or, more properly, a congestion of the mucous membrane of the air passages and a true bronchitis.

TABLE 7

ACUTE BRONCHITIS

Appendectomy	3
Post-operative ventral hernia	1
Nephrect., ureterect., cholecystost., and appendectomy	1
App. and post. gastro-enterostomy	2
Baldy-Webster and currettage	1
Abdominal hysterectomy	1
Cholecystectomy	1
Exploration cancer of stomach	1
Choledochotomy and cholecystectomy	1
Excision duod. ulcer and pyloroplasty	1
Pyloroplasty, Finney	1
Nephrectomy	1
Lig. right superior thyroid arteries	1
Closure fæcal fistula and app.	1
Closure fæcal fistula	1
Excision duod. ulcer and gastro-enterostomy	1
Gastro-enterostomy	2
Total	21

Group 4. Bronchopneumonia. These patients have the same symptoms as those of the preceding group, usually to a more marked degree. Inflammation here has apparently extended at certain points from the air passages into the tissues of the lung and the physical examination reveals areas of consolidation or congestion. Convalescence is slower than in the previous group.

TABLE 8

BRONCHOPNEUMONIA

Appendectomy	2
Resection pylorus	1
Gastro-enterostomy, herniotomy and appendectomy	1
Posterior gastro-enterostomy	2
Cholecystostomy and appendectomy	1
App. (acute abscess)	1
Thyroidectomy	1
Cholecystostomy	1
Enuc. eye and post-operative ventral hernia	1
Pyloroplasty	1
Total	12

Group 5. Lobar pneumonia. In this group are those patients who have a definite consolidation of the lung with a temperature of 102° or more and the classical symptoms of pneumonia. The temperature is more likely to subside by lysis than by crisis. We still believe that septic emboli cause many of these conditions. They rarely occur earlier than the third or fourth day following operation.

TABLE 9

LOBAR PNEUMONIA

Cholecystenterostomy	1
Pyloroplasty	2
Appendectomy	1
Abdominal exploration	1
Cholecystectomy and choledochotomy	1
Cholecystectomy	1
Thyroidectomy	2
Cholecystectomy and appendectomy	2
Gastro-enterostomy	2
Total abdominal hysterectomy	1
Anterior gastro-enterostomy	1
Total	15

THROMBOPHLEBITIS

The total number of cases having a thrombophlebitis was 14. Table 10 shows the number upon the right and left sides with the type of operation. We have not been able to determine any method of lessening this annoying complication. Most of our patients upon whom abdominal operations have been performed are out of bed by the eighth to the twelfth day, except those who have had simple appendectomies; these are allowed to get up on the sixth or seventh day following operation. There is a higher proportion of thrombophlebitis on the right side than has occurred in previous years. In our experi-

TABLE 10

THROMBOPHLEBITIS

	Right.	Left.
Nephrectomy	..	2
Exc. duod. ulcer, cholecystect. and appendectomy	..	1
Abdominal hysterectomy	2	1
Cholecystost. and ant. Hartman	1	..
Abdominal myomectomy	1	..
Vaginal hysterectomy	..	1
Abdominal hysterectomy	..	1
Cholecystostomy and appendectomy	1	..
Drainage large pelvic abscess	..	1
Gastro-enterostomy	1	..
Removal ovarian cyst with twisted pedicle	..	1
Totals	6	8

ence, patients with infection are not more prone to have thrombophlebitis than the so-called clean cases.

Acute Dilatation of the Stomach. It is to be seen that during the year this complication occurred in but three instances. We believe this distressing complication has been avoided by frequent and early lavage. A patient who continues to vomit after the first twenty-four hours is placed upon routine lavage. The stomach is washed once or twice a day, or oftener if it seems advisable, until vomiting ceases.

The other complications listed herein are such as are apt to occur in any large surgical clinic, but are not in sufficient numbers to warrant conclusions being drawn.

ACUTE DILATATION OF STOMACH

Cholecystectomy and appendectomy	2
Cholecystectomy and choledochotomy	1
Total	3

EMPYEMA CHEST

Transplantation right ureter for extrophy bladder	1

OBSTRUCTION OF BOWELS

Resection of stomach	1
Resection of urinary bladder	1
Nephrectomy	1
Total	3

SURGICAL RASH

Suprapubic prostatectomy	1
Appendectomy and currettage	1
Ligation right superior thyroid artery	1
Cholecystostomy and anterior Hartman	1
Total	4

CYSTITIS

Resection of rectum	2
Vaginal hysterectomy	1
Appendectomy	1
Total	4

POST-OPERATIVE MISCARRIAGE

Appendectomy	1

NEURITIS

Appendectomy (sciatic)	1
Subtotal abdominal hysterectomy (arm)	1
Total	2

ARTHRITIS

Appendectomy	1
Posterior gastro-enterostomy	1
Total	2

TONSILLITIS

Ligation superior thyroid vessels	2
Appendectomy	1
Total abdominal hysterectomy	1
Baldy-Webster operation	1
Removal lithopœdian	1
Total	6

DILATATION OF HEART, ACUTE

Thyroidectomy	2
Ligation one superior thyroid artery	1
Total	3

DELIRIUM TREMENS

Inguinal hernia	1

SLIGHT BLEEDING FROM WOUND IN CASES WITH MARKED JAUNDICE

Cholecystectomy and choledochotomy	2
Secondary choledochotomy	1
Total	3

URINARY FISTULA

Total abdominal hysterectomy and removal of portion of bladder	1
Supravaginal hysterectomy	1
Total	2

MEASLES

Transplantation of one ureter	1

PAROTITIS

Abdominal hysterectomy	1
Posterior gastro-enterostomy	1
Ovarian cyst-dermoid with twisted pedicle	1
Total	3

SCARLATINA

Choledochotomy and cholecystectomy	1

PANCREATIC FISTULA

Choledochotomy and cholecystectomy	1

FISTULA FROM GASTRO-ENTEROSTOMY

Gastro-enterostomy and cholecystectomy	1

ERYSIPELAS (FACIAL)

Cauterization of cancer of cervix	1

There were no fatalities included in the cases reported above.

HYSTEROMYOMECTOMY, ITS EVOLUTION AND PERFECTION[1]

By LEWIS S. McMURTRY, M. D., Louisville, Kentucky

WE are living in an age of marvelous scientific achievement. The advance of the science and art of surgery has been so rapid, and new methods are so quickly evolved, that we need at times to trace the steps by which we have attained existing results. Not only is such a retrospect interesting, but in many ways instructive and profitable. It is not at all uncommon in studying the history of an operation or other therapeutic resource to find the method adopted finally had been previously used and discarded. Thus in the light of experience and improved knowledge it is often necessary to retrace our steps and restore old methods to the place from which they had been stricken. A notable illustration of this fact will be found in the narrative I herewith present of the various steps by which the present surgical treatment of uterine fibroid tumors has been established. It will be noted that in the first operations for removing these tumors by hysterectomy the uterine cervix was ligatured and dropped in the pelvis. After many years, during which the pedicle was fixed in the abdominal incision by the aid of the serrenœud, clamp or elastic ligature, the original method, with certain modifications, was restored and remains in universal use. The one persistent and universal characteristic of all perfected surgical procedures is simplicity. As knowledge advances and precision increases, operative methods become more direct and uncomplicated.

The purpose of this paper will be best subserved by omitting a detailed account of the early surgery of fibroid tumors of the uterus. In most instances the earliest operations were stumbled upon when the operator expected to do ovariotomy. As in ovariotomy, American surgeons were prominent in the pioneer work of this operation, and have contributed the most essential features of the operation now so successfully practiced in this country. The names of Charles Clay and Spencer Wells in England; Burnham, Kimball and Washington Atlee in America; Koeberle, Schroeder and Hegar in Germany, and Pean in France, are associated with the foundation and early history of the treatment of uterine fibromata by abdominal section and excision of the tumor. So great was the mortality following the operation in the hands of its founders that it was not adopted by surgeons generally. With the exception of a few bold spirits who struggled on despite all discouragements and in the face of repeated disaster, the operation was regarded with disfavor. This was the status of the operation from its foundation in 1843 up to the advent of the Listerian era in surgery. The mortality of the operation during this period in the hands of skilled operators was from 30 to 40 per cent.

In 1885 Thomas Keith, of Edinburgh, issued a report of forty cases of fibroid tumors of the uterus treated by abdominal hysterectomy. This series embraced all the operations he had done up to that time, and extending over a period of twelve years. In all these cases the pedicle was treated extraperitoneally with the serrenœud or clamp. In all of these cases some antiseptic measures as taught by Lister were applied. In some the carbolic spray was used, and later abandoned. In the series of forty cases there were four deaths. As the antiseptic measures were crude and imperfect, the convalescence was in most cases protracted and febrile, but the results were so much superior to any previously recorded that the operation was established in professional confidence. Dr. Keith was at this time at the height of his physical and mental powers, and exercised a powerful influence upon surgical opinion throughout the surgical world. His monograph publishing in detail his work in this field is a model of its class. Indeed, it should hold a place among the classics of gynecological literature. If I may impose upon your indulgence for a momentary digression, I

[1] Read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

would quote one sentence from the introductory chapter of this book. Commenting upon the beneficent offices of the antiseptic system of Lister, he writes these words: "It is, unfortunately, a melancholy story that ever since surgery began, the most of the mischief was done by the surgeon himself. It was the willing and tender, though *unclean*, hand that carried the poison into the wounds."

Lawson Tait, of Birmingham, the founder of modern gynecology and the greatest surgical genius of his time, was born and educated in Edinburgh and was a frequent visitor there after taking up his residence in England. He witnessed Keith's operation, and with that skill which made him famous applied it in practice. He adopted the serrenœud and treated the pedicle as Keith did, and even surpassed him in the technique of the operation. He did more than any other operator to establish the operation in universal favor throughout the world. There was no marked improvement by these great Scotch surgeons in the operative technique of Koeberle, Atlee, and Pean previously described. The marvelous improvement in results was due to the application of Listerian principles and the elimination of sepsis. The same may be said of the work of Bantock and Thornton in London, who worked along these lines.

Up to this time the belief was firmly fixed in the surgical mind that the cervical pedicle offered peculiar difficulties. If ligatured and dropped, the tissues would retract and slip from the grasp of the ligature and fatal hæmorrhage would follow. Sloughing of the strangulated tissue and fatal peritonitis were attributed to the intraperitoneal stump. The serrenœud was invented and used to avert these dangers. After tying off the broad ligaments the pedicle was drawn up into the lower angle of the wound; pins were applied to retain the pedicle *in situ;* the serrenœud was placed and tightened and the tumor cut away. Some operators replaced the serrenœud with the elastic ligature, and another refinement consisted in stripping the peritoneum from the cervical pedicle and stitching it to the adjacent parietal peritoneum so as to assure an extraperitoneal fixation of the pedicle. But the sloughing of the stump, the protracted convalescence, the discomfort to the patient, and the frequency of post-operative hernia impelled surgeons to seek a method more surgical and refined. Many ingenious efforts were made to replace the extraperitoneal nœud with an intraperitoneal ligatured or sutured stump, but without avail until the procedure now to be mentioned was devised.

In 1889 Lewis A. Stimson, of New York, proposed and practiced the ligation of the four trunk arteries (the uterine and ovarian on each side) in their course. In this way mass ligatures were done away with, and the danger of hæmorrhage and sepsis enormously reduced. Following upon this J. Riddle Goffe, in 1890, made his valuable contribution to the technique of the operation, which consists in providing peritoneal flaps for the cervical pedicle so that it becomes extraperitoneal and at the same time intrapelvic. Other and important details were worked out by Dudley, Pryor, F. H. Martin, and Kelly, and in 1891, B. F. Baer, of Philadelphia, published the systematic application of these various modifications in the method of supravaginal hysteromyomectomy, with extraperitoneal dropped pedicle as now generally practiced. Various modifications have since been added to perfect details of technique. The operation was markedly advanced by the use of catgut throughout for ligatures and sutures, the adoption of the Trendelenburg position, and the use of rubber gloves. Without enumerating the numerous suggestions of various surgeons, such as cauterization and excision of the cervical mucosa in treating the pedicle, the operation as now done in America is as follows:

The patient is placed in the Trendelenburg position and the abdomen opened with a free incision. After exploring the tumor with the hand and separating adhesions, the tumor and uterus are delivered through the abdominal incision. The intestines are carefully packed off with gauze so as to expose the contents of the true pelvis. A heavy volsellum forceps may be necessary to secure delivery of the tumor. The broad ligaments are secured on each side with clamps, and

divided between two clamps down to the base of the tumor and near the uterine cervix. The peritoneum on the anterior face of the uterus and broad ligaments is divided, the incision extending from one round ligament to the other and the vesical peritoneum is then freed and pushed downward with a piece of gauze. Traction is then made upon the tumor, which is rolled over to one side and the uterine vessels are exposed by separating the broad ligament with a gauze sponge. The uterine artery is then secured low down on the cervix with a clamp. A ligature may be applied at this stage of the operation, or the vessels secured by the clamp until the tumor is removed. The same procedure is carried out on the opposite side. The cervix is divided below the level of the internal os, an effort being made to remove a wedge-shaped piece from the cervix, and a small posterior flap is formed by stripping up the posterior cervical peritoneum while the section of the cervix is being made. The cervix is closed with a few interrupted catgut sutures, thus making hæmostasis complete. The four trunk arteries, now securely clamped. are carefully ligatured with No. 2 catgut; the anterior and posterior flaps of peritoneum are now sutured across the floor of the pelvis and over the cervical stump with a continuous catgut suture. When there is a tendency for the cervix to prolapse, the upper border of each broad ligament together with the round ligament may be sutured to the cervical stump before covering the stump with the peritoneal flap. The peritoneal flap should be drawn snugly over the cervix so as to prevent the formation of a dead space. The pelvis is now cleansed of clots with the aid of gauze wrung out of normal salt solution, the gauze pack gently removed, the patient placed in the horizontal position and the abdomen closed. In removing the tumor, and while dealing with the broad ligament, for obvious reasons one or both ovaries should be preserved whenever it is practicable to do so. Even a part of one ovary should be retained if possible.

The advantage of this operation over all other operative procedures which have been devised for the removal of fibroid tumors by abdominal hysterectomy is its wide applicability. However irregular the growth may be, and however varied its morphology, the experienced operator will usually be able to work a path to the cervix and obtain a good pedicle. It is rare that the cervix is so involved in multiple tumors that it cannot be isolated and retained in place. This procedure has a distinct advantage over other methods in the reasonable time limit with which it can be carried out. By retaining the cervix the normal floor of the pelvis and relation of the vagina to adjacent structures is anatomically preserved. The objection has been made that the retained cervix may become the seat of malignant disease, but this is very rare. In a very entensive experience with the operation, covering several hundreds of cases some of which have been under observation for years, I have known only one instance in which cancer developed in the cervical pedicle after hysteromyomectomy. In my entire experience I have never injured the ureters in this operation. The mortality of this operation in average cases and at the hands of skilled surgeons is about 2 per cent. I submit that by no other procedure can these results be equaled.

In 1888 M. A. D. Jones performed the first total hysterectomy for uterine fibroma in America. Bardenheuer had preceded this operation, but his work was not known in this country at that time. This operation, known as panhysterectomy, has been modified in various ways. It has been practiced as an additional step in the operation I have described, the tumor being cut away from the cervix, the cervix seized with volsellum forceps and then removed in its entirety. Another method is that known as the combined operation, and consists of a preliminary vaginal dissection of the cervix, followed by abdominal section and hysterectomy as already described. A third method and one favored by many surgeons is that of Doyen. In this operation the uterus and the tumor are brought forward and over the pubes, the posterior vaginal fornix is opened through the pouch of Douglas, the cervix is drawn through the posterior vaginal walls laterally

and in front. The broad ligaments and uterine vessels are clamped, if necessary, and by continuous incision the fibroid is stripped out of its attachments. After the uterus has been removed, the adnexa are dealt with as indicated, the vagina closed with sutures and the peritoneum united over it.

Time will not permit bare mention of the numerous procedures devised by surgeons of all countries during recent years to cope with atypical cases and special complications in operating for uterine fibromata. These tumors grow in the most fantastic way, and dispose themselves with relation to the peritoneum and adjacent structures in great variety. Among the numerous methods devised for atypical cases one of the most valuable is that of bisection as practiced by Kelly.

With these various procedures the modern surgeon is prepared to cope successfully with every form and variety of uterine fibroid tumors, and will be prompted by sound surgical judgment to elect the procedure best suited to the case in hand. As a result the operation has become in the hands of trained gynecological surgeons the most successful major operation known to surgery. It is not the purpose of this paper to offer any new theory in pathology or to present any unique operative procedure, but rather, by going over familiar paths which those here assembled have trod, to confirm for the present at least the faith that has been tried and proven.

"EFFICIENCY ENGINEERING" IN PELVIC SURGERY: ONE AND TWO-SUTURE OPERATIONS[1]

By ROBERT L. DICKINSON, M. D., F. A. C. S., Brooklyn, New York

THIS paper is a plea for systematic study of our efficiency. If other handicraftsmen are employing experts to teach them how to eliminate waste motions and how to standardize technique, it behooves us to further such investigations in operating room, in ward, and in office. For beyond any other craft the surgeon's work demands the new "scientific management." It is not only that on occasions time is a matter of life and death; it is not only that speed is a matter of lessened shock and quicker recovery; it is mainly that habits of hand work controlled in the ways of the best motions by the automatic lower centers bring about freedom of the higher brain for those weighty decisions, that concentration on the rest of the problem, and that watchfulness of the patient which are called for in nearly every operation. No item is too small to think of, no training too laborious. All the way from printed directions for office patients up to dissection in the most radical cancer operations there is hardly a detail unworthy of consideration. The present question is how to attack the problem. It must first be defined, its parts allotted, the tentative results published for test by a number of operators, and a clearing house devised for combining conclusions. Meanwhile let us glance at some aspects of the matter.

Hospital Standardization. Toward the standardization of medical schools, here and abroad, a long first step was taken by disinterested outside study.[2] Whether we agree or disagree with the premises on which the estimates were made it is evident that the scope of the plan and the publicity cannot but be beneficial. The next great step is inspection and standardization of hospitals. This also must be undertaken in a large-minded way. In the October number of *The Modern Hospital* the editor, Dr. J. A. Hornsby, author of the recent book of the same name,[3] takes the ground that the

[2] Carnegie Foundation Reports on Medical Education, Bulletin 4, 1910.

[3] The Modern Hospital, Saunders, Phila., 1912.

[1] Read before the Chicago Gynecological Society, November 15, 1913. (See discussion, p. 649.)

physician is too close to the problems to solve them properly, and that he is often handicapped by working for a single department of his science. He argues, therefore, that one of the great foundations should make the investigation.

Does part of this investigation and standardization belong to our profession? I should say that the general surgeon or the special surgeon could best aid this work by analyzing a number of every-day procedures in the operating room or the ward, leaving questions of administration, of nursing organization, of feeding, of supplies, and the like to be studied by the efficiency engineer.[1] The time has come to urge that the national societies combine to undertake specific work in this direction.

In hospital management, until proper plans have been worked out, perhaps the most effective control in professional matters is by the clean-cut responsibility of one man committees. For example, the routine of the operating room is to be figured out, reduced to writing, and carried through by one of the surgeons. A careful consensus of opinion on the part of the various operators is scheduled and an average or standard technique agreed upon. Thus, let us say, two lengths of ligature are specified as regular, and three sizes of catgut, and nine different needles, which must always be ready. A routine form of skin preparation is to be employed unless a different one is specifically ordered. These are only examples. The individual equation and initiation are not handicapped, but departures from standard are recognized as such and radical alterations are matters of conference or arrangement. Thus what was haphazard becomes systematized, well understood, economical of time and material. Histories are placed in the hands of one man, who enforces a standard nomenclature of diseases and operations and an irreducible minimum of entries; the ward routine is in charge of another, who sees that not tradition but typewritten regulations rule. The dispensary, in professional matters, is administered by a third. Subcommittees or substitutes are allowed, but authority and responsibility are sharply defined.[2] Such men might be called the functional foremen of the health factory, bound over either to make good or to make way, being an effective executive committee, presided over by the man who appoints them, the president of the staff, and reporting to the staff, which is annually named by the trustees.

Clinical Travel.—Too much stress cannot be laid on the astounding stimulus systematic visiting provides for the overhauling and practical review of one's methods and resources. Not sporadic and occasional visiting, but that done at regular intervals with every second or third year a longer trip affording opportunity for making wide generalizations and time in which to do steady thinking. Any small group of men may, within six years, in reasonable vacations, inspect all the best clinics in their own line in this country and in Europe.[3]

In their travels selection may be made of those clinics whose efficiency will best repay an analysis looking toward the standardization of others. The example that springs first to mind is the Rochester clinic. The definition of authority, responsibility, and system in certain institutions; the remarkable teamwork in individual operating rooms; the laboratory equipment of some surgical departments, the follow-up methods of others; the impressive teaching devices of one man, the student's participation under another; the high average technique of a whole city—the best can be selected for study and emulation.

Illumination.—As an instance of the need of scientific studies let us take the subject of the illumination of the field of operation when that field is in a cavity like the vaginal canal or the laparotomy well. Hitherto all stress has been laid upon the attempt to get light as brilliant as possible. One way is by large skylights and windows, another by electric bulbs with reflectors, a third by the beam from an arc light outside the room reflected from one or more mirrors, as in the larger German clinics. As far as I know no study

[1] Reports by the Committee on Hospital Efficiency to the Philadelphia County Medical Society, June 17, and November 26, 1913.

[2] Dickinson. A Visit to Brooklyn Hospital. Long Island M. J., 1910, November.

[3] Dickinson. Clinical Travel, Brit. M. J., 1913, Oct. 18.

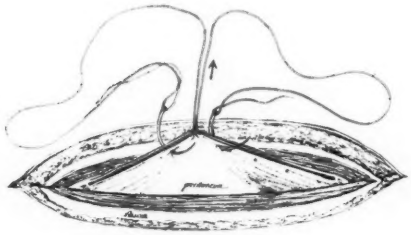


Fig. 1.

Fig. 2.

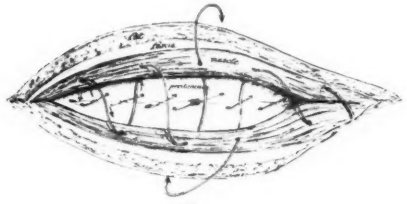


Fig. 3.

Fig. 1. Simplified method of closure of the abdominal wound, eliminating needle holder, several clamps, thumb forceps, and retractors. The peritoneum is picked up by a middle tie stitch; operator and assistant whip over toward the angles at the same time.

Fig. 2. The peritoneum is closed and the same stitch starts to close the muscle. It may be tied at each angle if desired.

Fig. 3. Longer sweeps approximate the muscle and the stitch is tied in the center of the wound.

has been made of the results in their bearing on the surgeon's retina. One's first idea would be that the brighter and more abundant the light the better. But this is not true. Indeed the paradox is truer that the more brilliant the general illumination the less will the eye see into deep caverns. The pupil contracts from the strong illumination of the entire room and particularly from the glare on white sheets and towels encircling the field. The eye is handicapped. With the beam thrown directly into the cavity the conditions are better but not yet right so long as the surroundings are all white. The most desirable arrangement would seem to be a room with ample light to enable the nurses

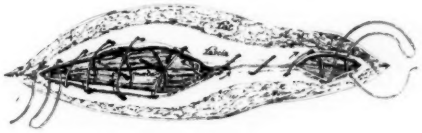


Fig. 4.

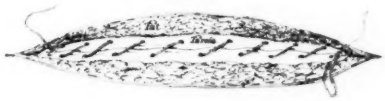


Fig. 5.

Fig. 6.

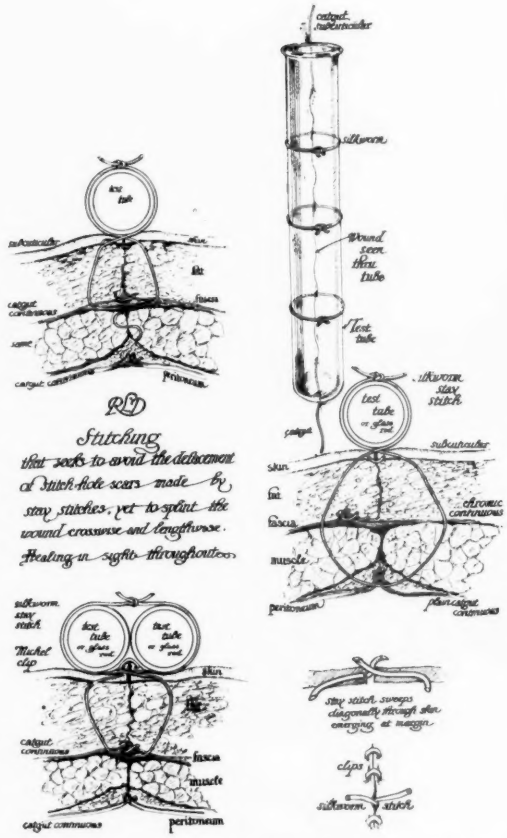
Fig. 4. The same strand goes on in two directions to close the fascia, beginning at the center.

Fig. 5. The fascial layer suture ends with a tie at each angle; this usually completes the layer suturing.

Fig. 6. Longitudinal section of wound. If desired, the same stitch may be used as a subcuticular, tying in the center of the wound with a knot that hides itself beneath the skin.

to find instruments and thread needles, with a beam of light thrown into the wound from more than one direction and the covers about the wound of a color of the same actinic value as the pink and red surfaces within. Black sheets look dingy. Red rubber (fortified with fabric) is an example of a color value of about the required intensity.

For night work it was long accepted that the ideal conditions for reading existed when, in a dusky room, a bright light was centered on the page, as by a shaded lamp, and in an operating room when a group of lights was equipped with reflectors to focus the light rays and with a glass screen to stop the heat rays. The eye men, however, have taught us that under these circumstances the pupil adjusts itself to the general darkness of the room and opens wide. Hence the spot of brightness hits the retina a blow. If this be true, then, in night operating, with a brightly lighted field, the rest of the room should show diffused lighting, and the environs of the wound a color value not far from that of the area on which work is being done. But this whole subject, as well as cross lights, sky-



Figs. 7, 8, 9. Stay stitches that leave no stitch-hole scar, the test tube being used as a bolster and a slanting grip of the skin edges taken.

light, summer glare, and so on, calls for the kind of study for which we plead.[1]

Abdominal Incision.—Suppose we select another every-day problem for time study and motion study, with the proviso that we all deprecate mere operating against the clock. In closing the abdominal incision, what is the swiftest simplification compatible with good workmanship? Restriction of the number of assistants and tools and motions with selection of the best of these in the best sequence—that is the matter for study. The irreducible number of tools would be a needle and a suture. Can we dispense with needle holder, retractors, the several clamps used to pick up peritoneum and fascia, and thumb forceps? Can some knots and sutures be eliminated? Can two men work simultaneously on the larger incisions?

Let us, then, on the simplest possible scale undertake various trials. Let us test this, for instance. A No. 1 plain or No. 0 chromic

[1] Grober, Das Deutsche Krankenhaus, Fischer, Jena, 1911. pp. 169, 172, 315, 536.

Fig. 10. Needle in which thread jams in a pointed eye so that it cannot slip out during operation (McRae).

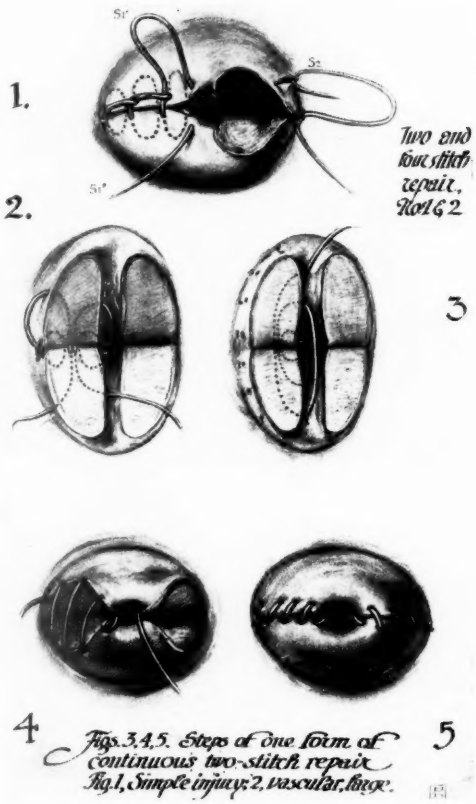


Fig. 11. Various forms of continuous suture as applied to cervix repair. These may be submucous in location.

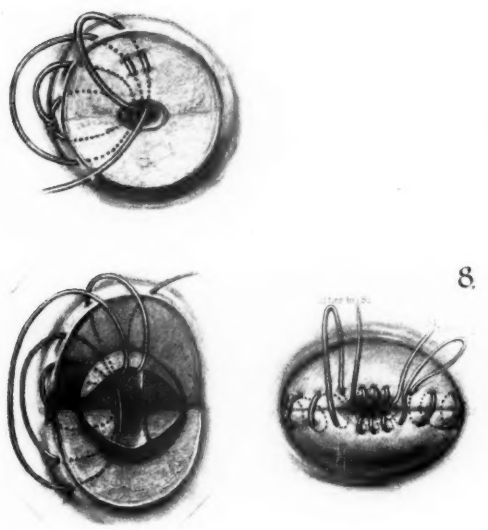


Fig. 12. Continuous suture in amputation of the cervix by a suture from each side.

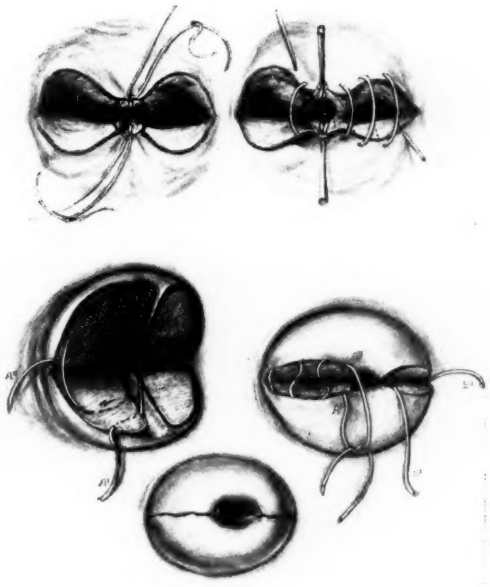


Fig. 13. Amputation of the cervix by two continuous sutures, the start being made in the center line.

catgut (20 to 28 inches long, according to the length of the incision) is armed at each end with a needle large enough to be manipulated without a needle holder and sharp enough to cut the skin but not to slice blood vessels (e. g., the Mayo-pointed). Two fingers pick up the peritoneum at the middle of the incision, and the suture is passed first through one side and then through the opposite peritoneal edge. The strand is tied midway of its length. After tying, traction lifts the peritoneum out of the wound in tent shape, exposing the upper and lower ends of the incision in this membrane (Fig. 1). The operator, in a continuous whip-over, closes the gap in the direction of the pubes, while at the same time his assistant, in all wounds but small ones, does the same in the direction of the navel. Having closed the peritoneum (Fig. 2), the same strand now doubles back, in longer sweeps, to approximate the muscle edges (Fig. 3), the two ends meeting in the middle of the wound, to tie there. Next (if thought desirable) the same stitch may whip the fascial edges together (Fig. 4), tying at the upper and lower ends of the fascial incision (Fig. 5). Indeed one could carry the scheme still further and use the same stitch for the fat layer or for a subcuticular, if one elected to indulge his fancy to the limit (Fig. 6). Naturally if plain catgut is used, silkworm stay sutures should supplement the support of the fascia. If one prefers plain catgut for the two lower layers and chromic for the fascia, the center-started stitch saves time here also, with incisions five inches or over. If stay sutures are employed, these may be so placed as to leave no stitch hole scar by crossing them at their exit from the skin margins of the wound and tying them over a bolster, which may be an ordinary test tube laid along the wound (Figs. 7 and 8).

The above are suggestions for trial. Many data there are to be worked out and individuals will give very different answers. The Michel clips, for instance, are commonly used in Germany for closure of the skin because of the speed of the procedure, and a long straight cutting needle, like the Keith, facilitates the placing of the subcuticular suture. The end results as to suppuration, broad and tender and unsightly scars and

Fig. 14

Fig. 14. Hysterotomy of both lips. Direction in which continuous sutures should be placed.

Fig. 15. Perineal repair by chromic gut. Frequent pussy appearance of stitch-holes as stitches drop out or are removed.

Fig. 15

hernia—all these are matters for such study as we are here advocating.

In this connection one might propound yet another problem. What is the best method of shielding the abdominal incision from friction, contusion, and infection? Concerning this I have long taken notes and have found precautions generally ignored or abandoned. I believe that no adequate solution has been worked out. Perhaps my shield retractor of rubber fabric with two springs may prove to be such in suitable cases (Fig. 21).

As a single example of the standardization of tools, a study such as we urge would make prominent a needle, a device twenty years in use, which seems to have escaped the notice of most surgeons, possibly because it was never published. A tapering eye jams the suture and prevents that not infrequent minor annoyance and delay, the slipping of the thread from the needle. When well made it does not cut the suture. It would seem that this MacRae eye should become standard, perhaps *the* standard (Fig. 10).

One more example, this time in training of right habits in handling instruments. Which is least fatiguing? The great German operators keep the gaze fixed on the field, reaching out a hand and calling for the next instrument. Thus the eye does not have to find an instrument and then re-focus on the exact

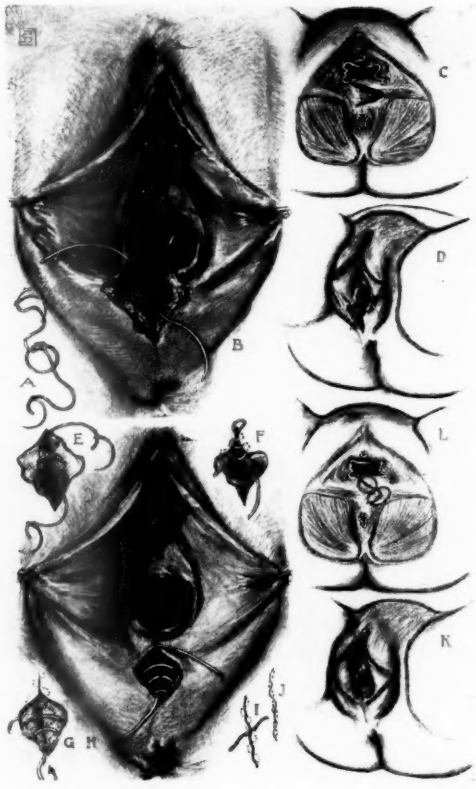


Fig. 16. Primary perineorrhaphy by layer suture, single strand, subcuticular. A anchorage in deepest portion of wound; particularly effective in irregular forms of tear. Result is accurate coaptation (L) almost invisible line of union (K).

point selected for seizure or suture. Again, Dr. F. F. Simpson does not have to look away from his work because each instrument, of those repeatedly used, lies in its own place, and there his hand finds it and there his hand replaces it. The commonalty among us sheds an instrument somewhat haphazard and has not only to look, but to search and select among a group, in recovering it. The new analysis studies all these ways. It might even consider whether a hand signal for an ordinary instrument might not save that delay or that mental annoyance of the moment when, intent on a grave issue, one must withdraw one's mind to form and voice

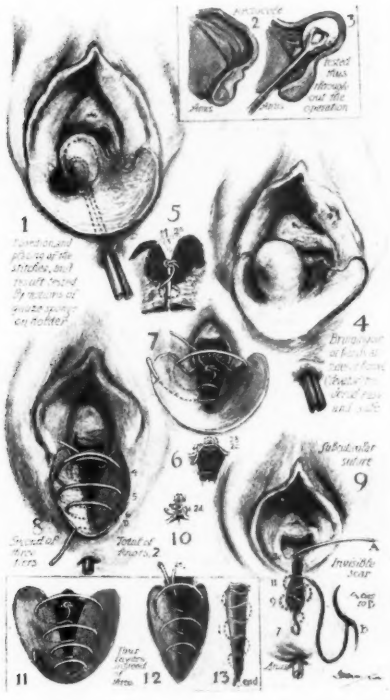


Fig. 17. Secondary perineorrhaphy by continuous catgut layer and subcuticular. The test of the rectocele (1, 2, 3,) and the guide to the levator (4) being made by stick sponge in the rectum. 11 and 12 show three and four layer method respectively.

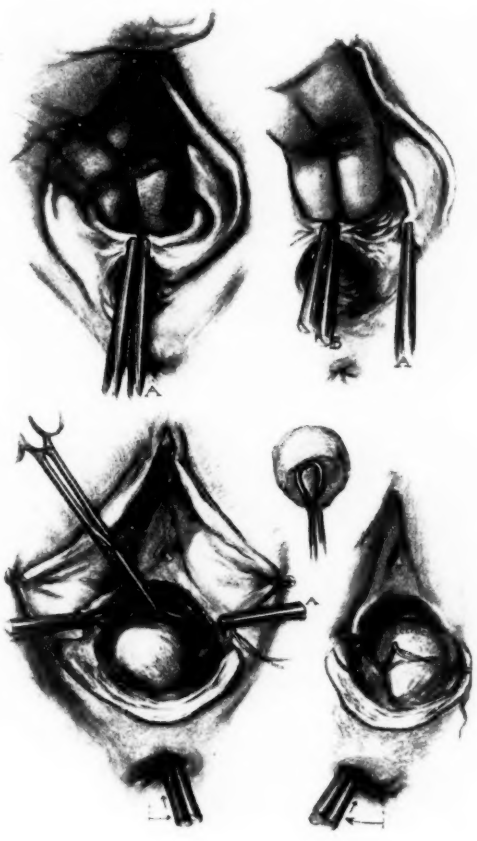


Fig. 18. The gauge of the amount of denudation. a-Kocher clamps seize remains of hymen and draw them over two fingers. b-Another grip, with another pair up lateral vaginal walls makes test further in. Stick sponge in rectum facilitates suture of levator.

the word "clamp" or "scissors." If Dr. Cochem is trying with his trained crew to develop silent operations he might go further and develop what might be aptly termed "pantomime operating." However this may be, when we train golfers, boxers, runners, to standard form and secure 100 per cent efficiency, why not laparotomists?

Repair or Amputation of the Cervix by Continuous Suture.— The usual cervix operation presents a tangle of multiple ties, say four on each side. Each stitch is taken, clamped, laid aside, until all are in place. Then they are unraveled from the bunch, right and left, and tied one by one, each being again laid aside after tying. Lastly scissors are taken to the whole group. It is found that the same result may be attained by two continuous sutures, with four knots instead of six, eight, or ten. Any one of three or four adaptations of the two-stitch method are available. A relatively thin cervix may be treated with a buttonhole suture with its crossings on the vaginal surface of the cervix (Fig. 11, "1"), using one stitch for each side of a bilateral laceration. When the cervix is somewhat voluminous and the tear long, Pomeroy uses two layers. The first turn and tie of the stitch is placed high in the cervical canal laterally, and then this lateral wall of the cervical canal is built down to the external os. From this point the same suture may be

Fig. 19. Primary perineorrhaphy with identification of torn levator and continuous suture of the injury by drawing the retracted muscle from the gully alongside the rectum forward toward the pubic arch.

continued outward under the vaginal surface of the cervix to the cervicovaginal junction (Fig. 11, "2 to 5"). As a rule, however, both sides of the canal are built before the external portion is added.

In amputation of the cervix the sewing may be begun at the outer angle and run inward (Fig. 12). The best way, however, is to start the stitching by a center sweep, with one end for the posterior and one for the anterior lip (Fig. 12, "8"). Each end serves as tractor and as a guide to the median line. The end with the needle is then run as a continuous suture, the rear stitch toward one side, the front stitch toward the opposite side (Fig. 13).

In those instances when pelvic floor repair is postponed to some time between the second and tenth day post-partum the uterine injuries should be mended at the same time. Continuous suture best effects this. A simple buttonhole stitch is easiest. If with two layers, one starts at the inner end within the cervical canal, grasps almost all the thickness of the cervix, and thus works down to the external os. Thence a submucous stitch, more or less exact, runs along the vaginal aspect of the cervix if necessary (13A). Pomeroy begins on the vaginal surface of the cervix at the rear in double hysterotomies, by running or buttonhole suture; next, the canal side; then with the second stitch, the opposite canal side; last, the remaining anterior vaginal aspect of the cervical lip (Fig. 14). In other words, the far side is done before the near side.

As skill is attained in all these procedures the outer layer is hidden so that no stitch and no knot is in view, but only a line of coated incision.

Perineorrhaphy.—For saving time and elaboration in perineal repair the one-strand, two-knot continuous suture has been found to be the simplest device. In most operations, whether primary or secondary, the center of a long suture may sweep and tie in the deepest part of the wound (Fig. 16 A, B), then the two ends whip over, one upward to close the vaginal gap (Fig. 16 E), and unite the mucous membrane over and over, or by a submucous stitch (Fig. 16 F), the other downward toward the anus (Fig. 16 H), finishing as a subcuticular, to tie to the first part (Figs. 16 I and K and 17 Fig. 17, "9"). We are ready to declare that upon buried catgut of small size entire reliance may be placed for pelvic floor repair after labor. It is even more satisfactory than in secondary operation. In our 58 fresh injuries of various degrees primary union resulted in all but one. We used either interrupted stitches closed over by running intercutaneous lacing, or tier suture with several strands, the last being subsurface; or else, as I prefer, a single strand run as continuous tier suturing, with two ends coming together, one submucous, the other subcuticular, the whole secured by one deep knot and one hidden surface knot. In any of these ways the

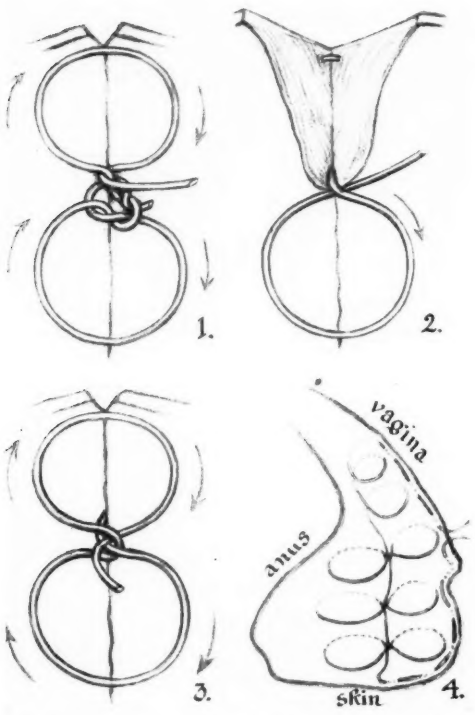


Fig. 20. Three tier suture, by the employment of the figure 8, which is continuous and middle-locking.

wound is practically invisible from the first. Levator laceration found immediately after labor particularly demands tier suture, and anterior fascial gaps are thus best united.[1]

In late perineorrhaphy, as now customarily done, where the levator muscle and fascia are drawn inward from the lateral sulci to be fastened side by side in front of the rectum (Noble) the single strand stitch works well. A convenient beginning may be made by placing the first sweep and tie at a point about two-thirds of the length of the suture and at the middle of the lateral bands that are to make the reinforced septum (Fig. 18). Traction on this stitch pulls down within reach the spreading V of the bands higher up so that a sweep may be carried beyond to draw these together (Fig. 17, "5"). This portion of

[1] Dickinson, Buried and Subcuticular Catgut in Primary Perineorrhaphies. N. Y. M. J., 1914.

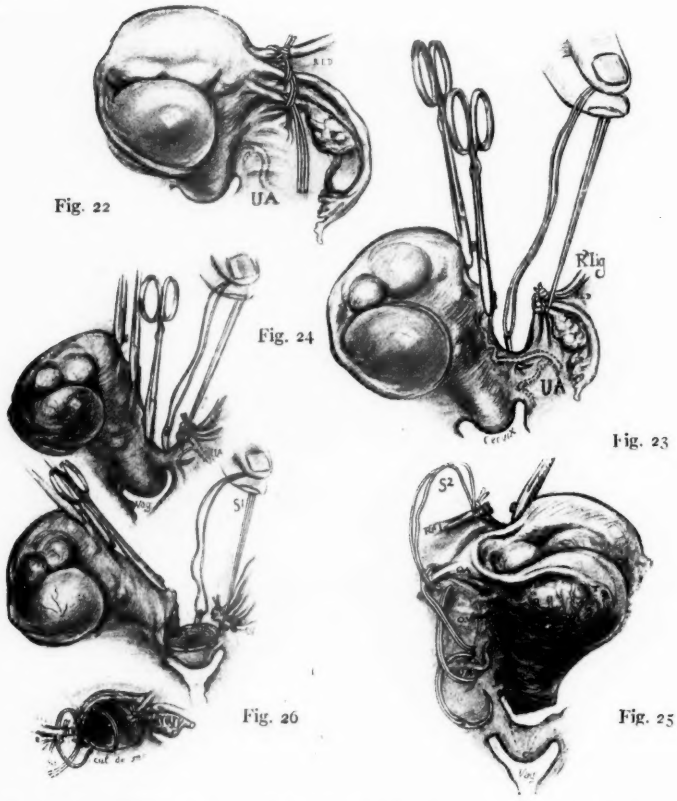
Fig. 21. Shield retractor guarding cut surfaces in abdominal wound.

the suture is thereafter of service to gather the rectal wall and to close the upper end of a Hegar triangle and eventually becomes a mucous membrane stitch or submucous lacing (Fig. 17, "6 x 9"). The end then hangs loose to wait for the completion of the operation, when it ties to the subcuticular coming back from the anal region (Fig. 17, "9").

Let us now return to the knot in the levator (Fig. 17, "7"). To draw together these bands three stitches are often desirable. Two have been placed. The third is now swept about the edges, and best from left to right (Fig. 20, "1"), in order to make the next stitch effective. It then takes any available order. To close the transversus and sphincter vaginæ muscles and then the superficial fascia either two (Fig. 20, "4") or three more layers (Fig. 17, "11 and 12") are employed. The aim is to have brought together everything but the skin on arrival at that end of the wound nearest the anus, so that the intercutaneous work may proceed toward the hymen and meet the first end there. If there be tension a stay stitch or two may be used.

Such one-stitch repair is a matter of practice. On small injuries it is easy. On the larger it works well in properly selected cases.

In levator lacerations, primary and second-



Figs. 22–26. Steps in the two stitch abdominal hysterectomy. Each loop is drawn taut before proceeding, and kept taut, serving also as a tractor. Into the deeply coned cervix — or vaginal edges — the round ligaments are made fast.

ary, the torn end of the pubo-coccygeus drops backward alongside of the rectal wall as, in a more superficial plane, the sphincter withdraws into a pocket. For anatomical replacement and the drawing forward of the hidden end toward the ramus the continuous suture is found to work better than the interrupted. (Fig. 19.)

Hysterectomy.—The elimination of waste motions in removal of the uterus led to combinations of ligature, suture, and tractor in one, intra-abdominal work I owe to Dr. F. F. Simpson, and the vaginal procedure is my application to the operation of Dr. J. Riddle Goffe. These methods are for the expert, and even he may, perhaps, at the first trial, combine the ligature with this suture.[1]

In simple cases two sutures suffice. I sometimes use more. It is spoken of as a two-suture method because the work usually can be done thus. There has been no slipping, no hæmorrhage, no death, in a series of forty-two cases.

Abdominal Hysterectomy.—The first bite of the suture is usually that which circles the round ligament (Fig. 21). The second stops bleeding from the ovarian artery (Fig. 22). In each case care is taken to bite into and

[1] Dickinson, Hysterectomy by Two Suture-Ligatures. J. Obst. & Gynec. Brit. Emp., Sept., 1913. Tr. Internat. Cong., Lond., 1913.

lock into tissue so that the ligature does not slip off a bared vessel. In every case and with every bite the loop must be snugly nestled home without slack or jump or stretch of gut between the bites, except as noted hereafter. Reflux being checked by a clamp on the uterine side, the upper vessels are cut away (Fig. 23). The thin part of the broad ligament is scrutinized. If it exhibits a bunch of varicose veins, sweep number three should encompass them (Fig. 27). We now cut away down toward the uterine, shoving back the bladder in front and peritoneum behind to bare or nearly bare the artery. The next sweep circles it (Fig. 23) and locks home (Figs. 24 and 28). The vessel is cut. The last sweep of the stitch as a ligature circles the vessels just to the side of the cervix (Fig. 24), and should get some grip in cervical or vaginal tissue for traction purposes.

Now one may with advantage repeat the procedure from the opposite side (Fig. 25). And for this reason. These suture-ligatures make convenient cervix tractors, and we may often dispense entirely with other clamps than those used to prevent reflux bleeding. Next, the uterus is cut away, taking care to cone the cervix in such fashion as to leave little or no cervical canal (Fig. 24). The cervix stump swings between two tractors, namely, the ligatures. One of these next approximates the two faces of the cervix crater, taking care to turn into this raw surface the cut ends of the round ligaments (Fig. 26), and it is then tied to its fellow of the opposite side. Finally, the second suture becomes the peritoneal suture and closes in all raw areas (Fig. 29). At any step in the process one may tie the strands, then go on with them. When the cervix is to be removed the same procedure holds good, substituting the words vaginal edge for cervix crater.

The same principle is applied to large uterine and ovarian tumors and pus-tubes, and to broad ligaments however distorted, by a variation in the procedure. Whenever there would be, between one artery and the next, a gap or space, and this would be crossed by a span of suture that could not be drawn taut, each artery can be securely grasped without altering the principle of this method.

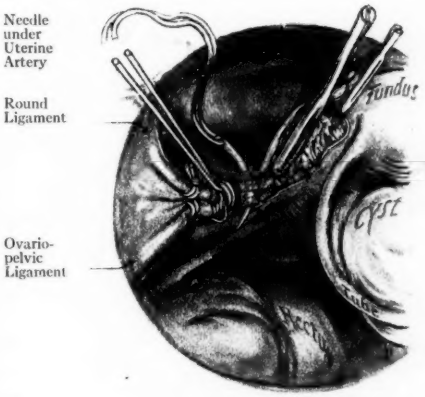


Fig. 27

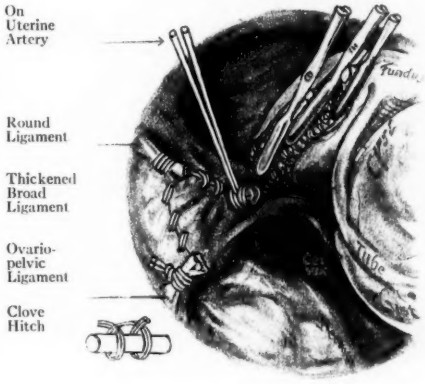


Fig. 28.

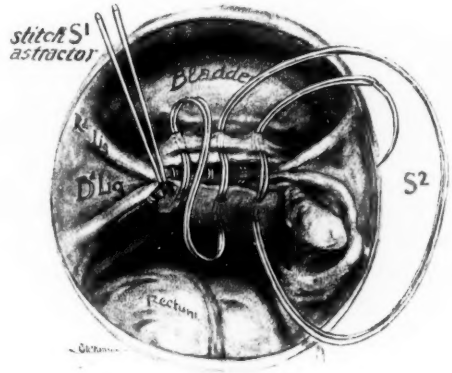


Fig. 29

Figs. 27, 28, 29. View into pelvis — stitches drawn large — to show closure of broad ligament at each step of ligation, and effective tractor action. Fig. 28, double bite, or clove hitch, used when any slack or line of delicate stitching intervenes between ligature action. Fig. 29. Peritoneal apposition over stump.

Figs. 30–31. The continuous double suture climbs the broad ligament; the second loop, here nestled home, circles uterine artery (UA). Second cut of ligament has been made. Tractor action shown. Fig. 30 — A small fundus may be extracted, then round ligament, then tube and ovarian vessels grasped by lock stitch. Or uterus may first be bisected. Or, on upper section of broad ligament, lock stitch may follow clamp and cut.

The vessel is to be caught in one loop, and afterward by a second—the second locking the first by the familiar clove hitch (Fig. 28).

Thus between the location of secure ligatures on several vessels, there can be lines or areas of mere suturing, all cared for by the same running strands (Fig. 28). The advantage is not only simplicity and speed, but also this: one does away with the curious and general practice of laying open wide raw spaces of connective tissue and then covering them in later. By coapting before cutting—or immediately on cutting—one closes the denuded areas, as it were, before creating them.

Vaginal Hysterectomy. The drawbacks to the lower route have been slowness and fussiness; occasional slipping of ligatures; oozing from broad ligament bases that spread wide open and retract into the bloody dark, and wide raw areas left uncovered by peritoneum.

If, by means of a long suture-ligature-tractor for each side—of fine, plain catgut, doubled—one sweeps about the vessels while he closes together and climbs and pulls down broad ligament, all by steps in the same process, then cuts the uterus out; thereafter, with one of the same stitches sews the ligament masses together, closes the peritoneum of the cul-de-sac, and cares for the posterior vaginal gap; with the other unites the anterior peritoneum, anchors the bladder, and cares for the longitudinal vaginal incision, all by running continuous suture,—he has, by a succession of well-reasoned movements, planned for the four requisites. The steps are as follows:

After the bladder is pushed back and the cul-de-sac opened and the base of broad ligament seized, cervix and stitch are pulled in different directions and a cut made between. This, or a second loop and cut, takes us close to the uterine artery. This sweep bites into tissue to anchor it and then circles the artery, is looped and carefully nestled home, and kept taut by the assistant (Fig. 30). Rarely a second, or locking loop, is applied. Next, the opposite side is treated in the same way. Now the uterus comes down so that the anterior

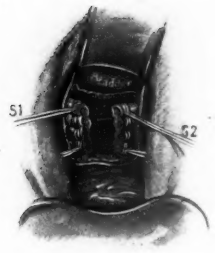


Fig. 32.

Fig. 33.

Fig. 34.

Figs. 32, 33, 34. Quilted broad ligaments ready to be sewed together. After anterior peritoneum is closed (not shown), bladder is sutured to top or rear of this strong bridge, Fig. 31. Cul-de-sac whipped over, then transverse and longitudinal vaginal openings approximated, catching the vagina up to the ligaments also.

peritoneal pouch is accessible for opening and widening. The fundus is drawn out. The suture either takes two more bites, round ligament in one (Fig. 31) and tube and ovarian ligament in the other before one side of the uterus is cut free, or else a clamp is applied, and after the uterus is out these stitches are taken. One must be careful to puncture and grip good tissue to prevent slipping,—for example, in the ovarian ligament. The upper end is now tied, shortening the broad ligament. The suture is not cut, however. The opposite side is treated in the same fashion. Care must be taken that in the jump between the ligating loops safe-guarding the lower portion of the broad ligament and those controlling the ovarian and round ligament vessels, there be no slack or span. The stitch should now be tied, and then continued to sew broad ligaments together, make fast the bladder and close the vaginal incisions.

CONCLUSION

If in all other workshops time, study, and analysis have resulted in doubling, with the same expenditure of energy, the output of the worker or cutting in half the time required to do a certain piece of work,[1] then the activities of all concerned in operating room and ward must be subjected to such study. Otherwise the profession is neglecting its plain duty. It now behooves us to call in the expert on scientific management to apply in our business of saving life and health whatever may be transferred from his experience in other fields. Each one of us may help by recording analysis and experiment in his own particular province, in those matters, such as details of operation, of which no outsider could be expected to have sufficient understanding.

[1] Gilbreth, Primer of Scientific Management, 1912.

PRELIMINARY REPORT OF EXPERIMENTAL WORK IN BONE TRANSPLANTATION[1]

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Instructor of Surgery, Rush Medical College. From the Nelson Morris Research Institute

THE question of bone transplantation and regeneration is one that has been before the profession for many years; in spite of which fact, no generally accepted opinion exists as to how or from what tissues the new bone is produced.

A brief review of the literature indicates how unsettled our ideas are upon this interesting and important subject.

Barth (1), in the Surgical Congress of 1893, stated that "all living transplanted bone died immediately whether with or without periosteum and that it was unimportant whether living or dead bone was used."

Axhausen (2) says: "There can be no doubt that fresh bone tissue planted in a defect dies throughout but that the periosteum remains alive and capable of reproducing bony tissue and it is probable that the bone-marrow retains its vitality."

Beattie (3), in his textbook of pathology, published in 1909, says: "The periosteum is composed of two layers, the inner being highly vascular and containing numerous osteoblasts. In operations on bone it is important not to injure this osteogenetic layer of the periosteum. The power to form new bone is not, however, limited to the periosteum, but is also exhibited by the tissue in the cancellous spaces and the medullary cavity."

Wieder (4), of the University of Pennsylvania, in a study of the healing of fractures in 1907, observed that "the bone-cells are confined and slow to react. They only form bone when liberated. The periosteum is early and free of reaction. The endosteum is most active. Both the periosteum and endosteum produce osteoblasts and osteoclasts."

Janeway (5), in 1910, in mentioning the few who at that time maintained the viability of the bone graft, stated that "all others have recognized the death of the implanted bone, its revascularization and penetration by granulation tissue, and, through this means, the production of new haversian canals, the lining of the new vessels with osteoblasts and the deposition of new bone in concentric layers around the newly formed blood-vessels." He also recognizes that "these changes are solely dependent upon the living and regenerative powers of the transplanted periosteum and marrow."

John B. Murphy (6), in 1912, in a very complete discussion of the surgery of the bones, joints, and tendons, concludes as follows: "Bone without its periosteum transplanted into muscle and cellular tissue always dies and is ultimately absorbed. When transplanted as above, with its periosteum, it practically always dies except in infants or very young children. If transplanted with or without its periosteum in the same individual and contacted with living osteogenetic bone at one or both ends, it acts as a scaffolding for the reproduction of new bone of the same size and shape as the transplanted fragment. The transplanted fragment, no matter how large or how small, is always ultimately absorbed."

Streissler (7), in an exhaustive review of the subject, says that "the best material for transplantation is living periosteum-covered human bone preferably from the patient himself. Bone transplanted without periosteum undergoes absorption and, therefore, should not be used for transplantation. Periosteum can be transplanted by itself and remain alive. It grows bone even when removed 100 hours after death in rabbits. (Bone-marrow when transplanted alone has osteogenic powers.)"

The publication of Macewen's book on the "Growth of Bone" (8), in 1912, with his many convincing experiments has resulted in a great stimulation to the experimental side of this question. His conclusions, briefly stated, are as follows: "The periosteum is not osteogenetic. The osteoblast has independent vitality and proliferative powers

[1] Read before the Chicago Surgical Society, March, 1914. (See discussion, p. 645.)

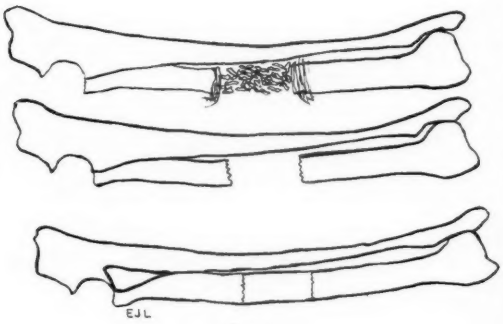

Fig. 1.

in the bone and soft tissues. The diaphyseal ends of the epiphyseal cartilages have great inherent reproductive power."

Cotton and Loder (9), in a report of an experimental study of the fate of bone grafts, report "uniform survival and healing in of graft, and, microscopically, a rapid covering of the graft by new endosteal bone laid down by the activity of the endosteoblasts in all portions of the graft, center, and periphery."

In contrast with these conclusions, Haas (10), in a series of experiments studying the regeneration of bone from periosteum, found that in working on the ribs, "Isolation of the rib from its periosteal bed caused atrophy with never any evidence of proliferation, nor was any evidence of union found in fractures produced in periosteum free bone. The severed ends of the denuded ribs inserted into the muscles never showed evidence of regeneration. New bone, forming at the angle of separation of the raised rib and periosteum seemed to follow along the periosteum and grow better in blood-clot. He believes that the combined action of the periosteum and blood-clot was responsible for the formation of the new bone."

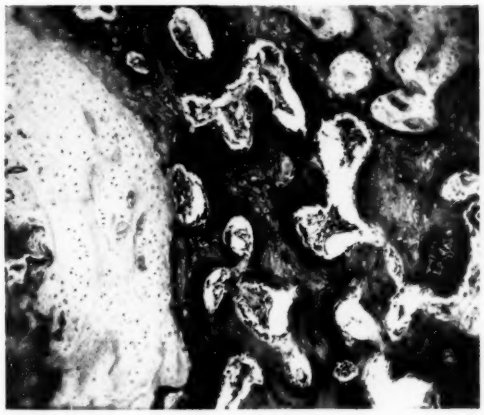

Fig. 3.

McWilliams (11), who has been one of the most persistent investigators of this subject from the experimental as well as practical point of view, concludes in an article published less than one month ago that "living bone grafts have life inherent in themselves and that the theory that contact with living bone is necessary for the subsequent life of grafts must be given up." He goes on to say that "93 per cent of periosteum covered grafts survive while 48 per cent of his bone grafts

Fig. 2.

Fig. 4. R, right; L, left.

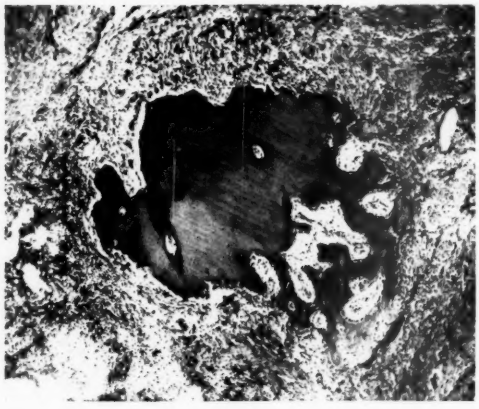

Fig. 5.

without periosteum lived. Also that in a certain number of cases he was able to produce new bone from periosteum transplanted into the soft parts."

The fact that a microscopic examination is necessary to determine whether a transplant has survived or merely "grown in" makes it impossible except in rare instances to draw conclusions from the many reports of successful bone transplantation in the human.

The contradictory results obtained by careful observers in the work or even by the same observer in a series of experiments can, I believe, be explained by the variations in one factor; namely, the amount of blood supply which the transplanted bone obtains. If we can prove that the bone-cells in a transplant can live and grow, we have the right to draw an analogy with the knowledge which we possess concerning the rules for skin-grafting where we have long agreed that, at any rate in autoplasts, the essential factor in obtaining a favorable result is the establishing of a sufficient blood-supply. I see no reason why the physiologic reaction of a bone-cell should in any essential degree differ from that of an epithelial-cell.

We have all known of failures in skin-grafting because the transplant failed to "take," or in other words to obtain sufficient nourishment for life and growth. The same explanation can, I believe, be made to hold good for our results in bone work.

It has been with this idea of blood-supply in mind that I have been working for the past year. The cases cited in this report have been limited almost entirely to the one phase of the problem which I consider essential as a basis for further work; namely, the study of the cortical bone itself distinct from its periosteum and marrow in an attempt to prove the viability and proliferative powers of the bone-cells which are therein contained.

This work has been done at the Nelson Morris Research Institute and a total of twenty-seven dogs have been operated upon thus far, of which reports concerning eight have been included in this paper.

Transplants from the same animal were used and the work was done as far as possible upon young dogs. The usual technique was to resect three to four centimeters of the shaft of the radius or ulna. The resected fragment was then split and the periosteum, endosteum, and marrow thoroughly curetted away. In order to obtain the best possible nourishment, the resected bone was then divided into many small fragments averaging three millimeters in diameter and one millimeter in thickness. The opposite leg was used as a control in some of the cases and the same technique followed here, except that the bone-cells in the fragments were killed by boiling for five minutes before use.

The many fragments of bone prepared as above were replaced in the cavity left by the original resection. In some cases the adjacent cut ends of the shaft were allowed to remain open, in others the ends were closed by periosteal cuffs or fascia and muscle flaps. After the fragments were replaced, the overlying muscles and skin were closed with catgut and plaster casts were applied for from

Fig. 6.

two to three weeks. The drawing (Fig. 1) shows roughly the general method followed in most of these experiments.

Experiment No. 1. Dog No. 11. Gives the findings nine weeks after operation in a case where the bone had been prepared as described above and had been replaced in the original cavity, the adjacent ends of the shaft being left open. The X-ray (Fig. 2) and the post-mortem examination established the fact that complete bony union of the many small fragments had occurred. The new-formed bone was irregular in outline and increased the diameter of the radius about one-half at this point. There appeared to be no interference with the interosseous membrane and pronation and supination was free.

The report of the microscopic examination (Fig. 3) is as follows: The section was removed from the upper end of the irregular mass of bone so as to include a portion of the old bony shaft and the new bone. Live, actively growing new bone was to be seen throughout this section firmly uniting the original transplants to one another and to the end of the shaft. No evidence of "growing in" from the end of the shaft was observed. Throughout the entire section it was only possible to find one or two of the transplanted fragments which had failed to survive. The rest were all alive and apparently actively engaged in the production of new bone.

Experiment No. 2. Dog No. 14. This dog was posted in five weeks, the fragments having been prepared in the same way as in Experiment No. 1, the difference being that the left leg was used as a control. On the control side the fragments of bone were boiled for five minutes before being replaced. The ends of the shaft were left open on both sides. The examination at post-mortem shows a marked difference between the two sides. On the left side

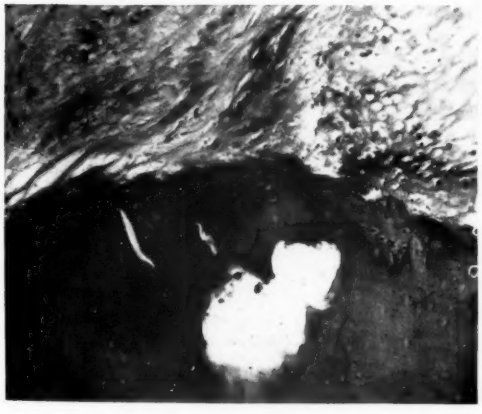

Fig. 7.

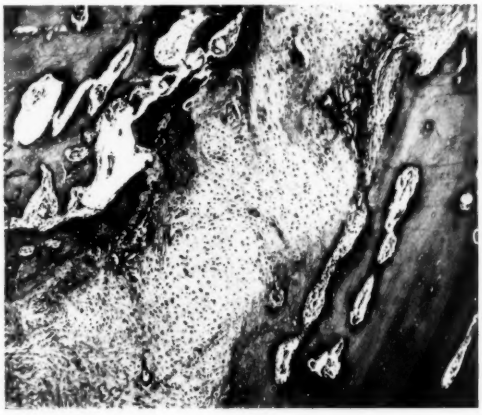

Fig. 8.

where the fragments were boiled before replacing there was a complete failure of union, the transplants being freely movable in a loose, connective tissue in which the individual pieces of bone could be felt. On the right side, a fairly good bony union was found to exist. Ossification, of course, was not complete and the new bone could be bent, but the fragments were all united in one mass and the surface of the new bone showed the irregular markings of inclusion of the original fragments in the growth.

The X-ray (Fig. 4) of the two sides bears out these post-mortem findings inasmuch as the separate particles of dead bone on the left side can be readily made out, while the fragments on the right side have grown together in a mass with a loss of definition in the outline of the original transplants. In this experiment, if the new bone were derived from the adjacent ends of the shaft, there should be no difference in the findings of the two sides.

The microscopic report is as follows: The section was taken from the firm mass of callus in the right leg. Throughout the section can be seen the original transplants of bone. Most of these have lost their cellular structure at the center, but along their periphery the bone-cells persist and in many areas bone trabeculæ consisting of osteoblasts and capillaries can be seen growing out into the granulation tissue or extending to near-by transplants uniting the grafts in one bony mass. The area included in the microphotograph (Fig. 5) shows one of the smaller transplants lying free in the granulation tissue. Along its entire periphery the osteoblasts can be seen laying down new bone and along one border a network of bone trabeculæ is seen to be growing out. There can be no doubt that this new bone is derived from the original fragments and that the growth is from the cortical bone and is independent of periosteum, endosteum, or marrow.

Experiment No. 3. Dog No. 17. In this case

Fig. 9.

the bone fragments were obtained as described previously, the difference in the experiment being that the post-mortem was held twenty-one days after the operation. The X-ray examination (Fig. 6) failed to show that ossification had taken place between the fragments, but it also indicated that there had not been any extensive growth from the adjoining ends of the shaft which had been allowed to remain open. The transplanted particles could be felt in the callus which was extensive but still quite soft. The microscopic specimen was made from tissue removed only twenty-one days after the operation and failed to show the extensive formation of new bone trabeculæ that was to be observed in the older sections. Except at the periphery of the grafts, most of the nuclei in the transplants have disappeared; however, along the margins of most of the bone-fragments are layers of actively growing new bone (Fig. 7). This same new bone layer can be seen lining the haversian systems and the spaces within the bone substance, probably indicating that on these surfaces the supply of nourishment permitted the bone to survive, whereas in the deeper and more solid portions the cells had perished from lack of nutrition.

Experiment No. 4. Dog No. 23. Examination was made after 35 days. In this case the fragments were prepared as described, but the adjacent cut ends of the shaft were sealed off by flaps of muscle and fascia. There was, of course, no union other than fibrous between the mass of transplants and the

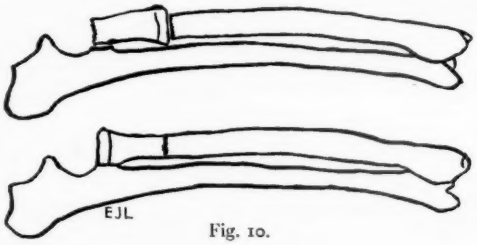

Fig. 10.

Fig. 11.

adjacent bony ends of the shaft. This mass was fairly firm but bony union could not be said to have occurred. The microscopic section was made to include the sealed-off portion of the shaft on one side, and the tissue between, containing a portion of the transplanted fragments. It shows very beautifully the effectiveness of the fascia and muscle-flaps in limiting the growth of the shaft into the open space. Below this limiting connective-tissue mass may be seen two fairly large fragments of transplanted bone (Fig. 8). They lie a short distance from one another and have grown together in one mass, the new material being actively growing bone and cartilage. From the appearance of this section there can be no doubt but that the new bone and cartilage tissue are derived from the original transplanted fragments. At other points may be seen small fragments of transplanted bone which have survived and which are serving as centers for new bone formation. In this experiment the sealing off of the cut ends of the shaft has prevented (if such a thing were possible) the entrance of osteoblasts into this area. In connection with this experiment I should like to show the X-ray (Fig. 9) of a case where the same technique was used as in Experiment 4, except that boiled bone was used in the sealed-off area on the left side as a control. The X-ray (taken thirty-two days after operation) indicates the extensive absorption of the dead bone that has taken place, the amounts of bone used originally on the two sides being approximately the same.

Experiment No. 5. Dog No. 12. This dog was posted nine weeks after the head and about three centimeters of the shaft of one radius had been removed, the articular surface scraped off and the fragment replaced with its original position reversed (Fig. 10). In other words the shaft end of the bone fragment removed was now adjacent to the elbow-joint. The periosteum was not removed

in this experiment nor was the adjacent end of the shaft sealed. No attempt was made to close the elbow-joint. The fascia muscles and skin were closed with catgut and a plaster cast applied for the first three weeks. No complications occurred, and when the dog was observed shortly before post-mortem he appeared to be using both forepaws equally well. On cutting down on the elbow, the joint cavity was found to be functionating and to have been restored to normal. A slightly increased amount of joint fluid was present. The end of the transplanted fragment adjacent to the joint had assumed somewhat the contour of the head of a radius and a bed of cartilaginous-like material had formed over it. Moreover, the capsule had become continuous with the covering of the transplant, so that, as stated above, there was a complete restoration of the anatomic relations in the joint as well as physiologic function. The distal end of the transplant was found to be firmly associated with the shaft of the radius. There was no evidence of atrophy of the bone. The microscopic report follows: The section was taken from the original transplanted bone and includes both epiphysis and diaphysis, with the epiphyseal line between. Microscopical examination (Fig. 11) establishes beyond any doubt the complete survival of this transplant. The cellular structure of the epiphyseal line can be readily made out and the columnar arrangement of the cartilage cells on the dia physeal side is retained. The cell-nuclei retain their full staining powers throughout the entire specimen.

I do not think that any one will deny that this transplant lived and was not merely grown into by the adjacent bony shaft. If such had been the case, we would certainly not expect the survival of such a definite anatomic structure as an epiphyseal line, or the differences which we recognize in the appearance of epiphyseal and diaphyseal bone. The question of the possibility of transplanting the epiphyseal cartilage, with retention of its function of producing longitudinal growth, is a fascinating one that deserves careful investigation.

Incidental to this work I wish to report an observation of a case where a portion of bony shaft 3 centimeters in length was removed and the adjacent periosteum of the ends of the shaft thoroughly scraped away. The interval between the ends was then surrounded by a transplant of fascia which was made to extend up and down along the shaft for some distance. At the post-mortem nine weeks later complete bony filling in of the space with excessive callus formation had occurred. The fascia transplant had fused above and below with the periosteum and could not be differentiated from it.

In another experiment (Dog No. 13) the same method was followed except that no fascia transplant was used, the space between the ends of the shaft being allowed to fill with blood-clot. In this case no periosteal or bony bridge was allowed to remain, in spite of which fact, at post-mortem nine weeks later, a good bony filling in of the space was found to have occurred.

I wish to submit the following conclusions based on the experiments reported on:

1. That cortical bone, free of its periosteum, endosteum, and marrow will retain its vitality and proliferative powers when subdivided into small fragments and replaced in the tissues. Also that contact with living bone is unnecessary for the growth of these transplants.

2. That larger pieces of bone may be transplanted and remain alive—not being merely grown into by the bone in which they come in contact.

3. That bones may unite after fracture or a space fill in after resection without the aid of any periosteal or bony bridge, and that transplanted fascia may be made to take up the nutritional and limiting functions of the periosteum.

The matter of the survival of a transplanted epiphyseal cartilage cannot be said to have been proven but suggests the value of additional careful experiment.

I wish to extend my thanks to Dr. J. W. Jobling and Dr. D. N. Eisendrath for many helpful sugestions and to Dr. H. G. Wells for looking over the microscopic slides. Also to the internes of Michael Reese Hospital for assistance at the operations.

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THE TRANSPLANTATION OF BONE IN POTT'S DISEASE[1]

Exhibition of Cases Operated by Albee's Method

By EDWIN W. RYERSON, M. D., Chicago

I HAVE no evidence to bear out any of the various theories which Dr. Lweis has advanced, many of which are familiar to me. It is difficult to believe in view of the experience which I have had in thirty cases of bone transplantation that the bone dies. If it dies, it does remarkably good work after it is dead. It is hard for me to comprehend the actual death of the bone, because in cases of death the bone should lose its function, but in the cases which I am about to discuss the bone does perform the function which we most desire it to perform.

I have in thirty cases resorted to bone transplantation; twenty-eight of these were for Pott's disease, in which the operation of Albee was performed. Albee himself operated in my clinic four of them, at which I assisted, and the other twenty-four were done by me. Two years ago in December, the first three operations of this kind were done in my clinic, and two of the cases done at that time are here to-night.

In November, 1911, this boy had a large sized kyphosis in his upper dorsal region; he was in bad condition; he seemed to be a bad surgical risk. He was growing worse so rapidly, however, that we were glad to accept the risk, and I accordingly performed Albee's operation, January 12, 1912. Two other boys had been operated by me, both in November, 1911, with apparently good results. The technique of the operation is well known, so there is no need to go into it.

In the first three cases I mentioned the bone grafts were cut out with a chisel and mallet, a method vastly inferior to the motor saw. The bone-splint in these first cases was small; it was light; it was bent around the large kyphosis which you see here, and in a couple of months the boy was allowed to be up and about without a plaster jacket because the disease was so high up that the plaster jacket would do him no good. The symptoms of tuberculosis of the spine had disappeared at the time he began to walk around; that is, he no longer had pain; he no longer had disability; he no longer had rigidity of the muscles up and down the spine—the erector muscles. I have not seen him for a long time, and his deformity seems to have increased slightly, but that is partly due to the compensatory curves which have increased below and above the seat of deformity. I cannot distinctly feel the bone splints. We have no X-rays of these two cases.

In my second case, the little boy's kyphosis is slightly evident. This was the apex of it. As he bends, the apex of his kyphos shows up, but he has no difficulty in doing it. He is in good condition and there is every evidence that he is entirely cured. This boy was operated more than two years ago, November 23, 1911. The first boy is thin and pale and weak. His result does not seem to be quite as brilliant as the others. He also has tuberculosis of the hip-joint, which has probably delayed his recovery. The second boy is a remarkably good result. The third case operated on over two years ago seems perfectly well although the size of his kyphos was not diminished by operation.

Case 4. A young lady who was operated after the results of the original three cases were seen to be satisfactory. In December, 1912, that is, about fourteen months ago, she was operated at St. Luke's Hospital during a meeting of the Central States Orthopedic Association.

I had treated her for one year previous to the operation. It was difficult to keep her quiet enough; she was getting worse. She was operated upon a year before at the Michael Reese Hospital by one of the surgeons there for appendicitis. She had recovered from that, and at the time I decided that an operation was necessary she had developed an enormous psoas abscess. The abscess was aspirated at St. Luke's Hospital and a pint of pus removed. Not all of the pus was removed, but all I could readily remove with the aspirator, and two weeks later, the aspiration hole having healed, she was operated by the Albee method. We put in a large splint cut with the motor saw. Here was the apex of the deformity. I made no attempt to remove the projecting spinous process. She has been well since three months after operation, and almost immediately after operation the severe girdle pains disappeared. She has since gained in weight and is apparently perfectly normal. Bending makes the apex of the knuckle rise up a little bit, but the bone-splint, which was at first not securely anchored at the top, has solidified within the last six months. She feels weak without corsets, but seems to be doing very well. The abscess has entirely disappeared.

Case 5. The boy exhibited had a complete paraplegia, so that he was unable to move his legs at all. Six years ago I began to treat this boy for Pott's disease in the orthopedic clinic we had at Rush Medical College. He went from bad to worse; he became extremely emaciated, until he was

[1] Read before the Chicago Surgical Society, March, 1914. (See discussion, p. 615.)

nothing but a skeleton. Then he developed paraplegia and seemed as hopeless a case as I have ever seen. With the consent of the parents we put in a strong Albee splint, scored underneath so it would bend more readily, and within two weeks the paraplegia improved, and within a couple of months he was walking around the ward. He had the same condition of kypohosis that he had when I operated on him. We did not succeed in straightening him, but he has made a gratifying recovery.

CASE 6. The next patient, a boy, was treated for two years at the Children's Memorial Hospital by extension and rest upon a Bradford frame, and he grew worse. Every time we got him up in a plaster jacket he began to go down hill again, and it was at last decided to do the Albee operation. He had a sharp knuckle at the time the operation was done, and I did not succeed in straightening it as much as we have been able to do in some cases. But he has improved rapidly and has gained in weight.

CASE 7. Another boy treated by me for two years for Pott's disease had several sinuses, some on the thigh, and one in the groin. He was operated upon about six or eight months ago and has been running around the wards without apparently any signs of a sensitive spine.

CASE 8. Was operated three months ago, and to-day he had his cast removed. One stitch came out at this point, but otherwise the wound healed uneventfully; the back has become much straighter than it was although the cast was only removed this afternoon.

CASE 9. This case, a girl, had a severe psoas contraction from a psoas abscess, the disease being in the lumbar region. The bone-splint had to be inserted into the two upper sacral spinous processes as well as in the lumbar. The splint did not attach itself firmly at first, and apparently is not set in as deeply as it should be, but it does not separate either at top or bottom as she bends over, and she says that her back feels perfectly strong and well. She was operated on March 17, 1913.

CASE 10. Was a girl who had a large angular deformity which was operated upon the thirteenth of November, 1913. She has a tuberculous left elbow besides the trouble in the spine. The result is very good.

CASE 11. This boy, who was operated last December, seems to have a pretty straight back. He had had a sinus on the side, which has closed, and he seems to be free from symptoms.

CASE 12. Here was a severe case operated by Dr. Albee at my clinic. She was one of the cases treated I think for three or four years with a rapidly progressing deformity, which was more severe at the time operated on than now. Her back has straightened up to some extent. She had a splint put in four or five inches long and she has done remarkably well.

CASE 13. Here is another case which shows a good result. This was a sharp projecting knuckle like the knuckle of a bent forefinger, and it was possible to straighten it up considerably.

A number of these children have been definitely straightened and some have not. We took a series of X-ray pictures of the large girl's back at different times. They show in the negative better than in the print, and demonstrate that the bone-splint is spliced in there solidly, although the union at the upper end is not clearly shown.

These cases, with the exception of the large girl, all came from my clinic at the Home for Destitute Crippled Children, no attempt being made to bring those from the Policlinic and the Children's Memorial Hospital.

In my opinion, Albee's operation is a very important addition to the treatment of Pott's disease. Practically every case can be benefited by it, for a great many of the cases apparently cured by conservative mechanical treatment are later seen to relapse. The operation certainly gives rapid relief to the subjective symptoms in all successful cases, and while we cannot believe that the actual tuberculosis disappears as rapidly as do its symptoms, we can nevertheless be sure that it will disappear more rapidly in those cases where more perfect fixation of the diseased portion of the spine is obtained. The operation of Russell A. Hibbs is essentially as sound in principle as that of Albee, but I have so far had no experience with it.

BONE TRANSPLANT[1]

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FOR many years efforts have been repeatedly made to improve upon the method of mechanical aid which is used in the correction and treatment of certain types of deformity, the predominating inclination being to get support under the skin. Prof. Lange [2] of Munich four years ago at Washington called attention to the classic work of Carrel, who opened the prospect of supplying diseased or lost parts of the body by transplantation of parts of other men. Twelve years ago Lange was hard at work on the problem of tuberculous spondylitis, trying to devise some means of giving support to the spine and relieving the pressure from the vertebral body by means other than recumbency, cast, or visible brace, and in 1910, in an article entitled, "Support for the Spondylitic Spine by Means of Buried Steel Bars Attached to the Vertebræ," [3] made a plea for what he called heteroplastic. He asserted we should further develop it, because we always have inorganic material at hand in any quantity as a substance. At this time he reported a case of tuberculous spondylitis treated with the insertion of two steel wires, tin plated, which were placed along either side of the spinous processes. This idea of a metal support beneath the skin is not indeed successful, but is interesting as the forerunner of the bone support, which must now be regarded as successful.

The development of under-the-skin bone support by Albee in tuberculous spondylitis in New York, and its successful repetition in Chicago and elsewhere, is so gratifying in selected cases of this disease and of fractured vertebræ as to make it a popular treatment growing in favor and tending to replace other methods of operative support for these deformities.

A few of the additional possibilities of the bone transplant are:

1. To plate fractures in long bones, thereby diminishing the possibility of suppuration and of a second operation, in comparison with the Lane plate.
2. To supply congenital deficiency in long bones.
3. To retain corrected or near-corrected position in scoliotic spines.
4. To replace resected tuberculous joints.
5. To hold the over-corrected talipes equino varus foot in position by placing a wedge of bone taken from the tibia in the groove made by the over-correction and in hip pegging, as suggested by Albee.
6. To supply loss of bone following osteomyelitis.
7. To replace joints resected for cyst or malignancy, using strips of tibia taken from the same patient, as in A. E. Halstead's shoulder case, not yet reported. At this time I will consider only cases covered by headings 1 to 4.

1. *Fractures in long bones and bone transplant.* As suggested above, the use of metal in general is unsatisfactory. This method as represented by the Lane plate seems from careful study of the statistics of a number of cases to be used frequently when simple methods should suffice, and when used it is more or less inclined to aid the tendency toward suppuration. In about forty-eight per cent of one series of cases studied there was suppuration or a second operation required to remove the plates. The suppuration is to my mind caused by the Lane plate, and by nothing else. The Lane technique is known to be superlatively careful, and it must, therefore, be the irritation from the Lane plate which causes the trouble. In coming to this conclusion I have had in mind that in my orthopedic services involving a considerable amount of open operative work on the long bones of children and adults, in operations on congenital and rachitic deformities, before and after complete ebonization and on old ununited and malunited fractures, I have had practically no suppura-

[2] Lange, Am. J. Orth. Surg., viii, 345.
[3] Lange, Am. J. Orth. Surg., viii.

[1] Read before the Chicago Surgical Society, March, 1914. (See discussion, p. 645.)

tion. In a series of thirty-four transplants removed from the tibia, some of them ten inches long, there was no infection; there was, however, slight infection in the wound where the transplant was placed in four of the cases. In one of these the trouble was believed to be caused by the heavy silk used to anchor the transplant; one was a stitch abscess which readily healed, and the other two gave evidence of being in the soft tissue, nearer the skin than the transplant. In none of these cases have the transplants been removed or been in such a condition as to indicate removal. A number of very extreme anterior bows of the tibia were openly worked on, often with marked trauma to surrounding parts, and handled with several sets of hands; also wedges of bone and strips of bone were cut away from the crest of the tibia for æsthetic effect only. In none of these cases here referred to, in which there was so much handling of the bone, was a second operation or anæsthetic necessary, as was the case in the series of cases before referred to, in which the Lane plate was placed. The Lane plate, and it alone, makes the Lane technique necessary, and this most careful technique, as shown by the results, seems to indicate the substitution of some other method where possible.

One case presented itself in which I had the opportunity to use a bone-plate precisely as a Lane plate is used. I am not at liberty to report on this case in detail, as it is soon to be published, but I may say that the result was satisfactory, and justifies a careful study of the application of the bone-plate in selected cases of fractures, if plates are necessary, instead of plating with foreign material.

2. *Congenital deficiency in long bones and bone transplant.* Cases having a congenital absence of some part of a long bone lend themselves most favorably to bone transplant, and those where the entire bone is absent should be considered as possible subjects for benefits from this kind of surgery. As illustrative of congenital total absence of a bone, as far as röntgen ray aid gives evidence, is a child two years old, in whom the fifth metacarpal bone of the right hand was absent; the little finger and its phalanges were, however, present. Fair motion in the little finger discouraged its sacrifice by amputation. The possibility of bone transplant was now considered. In a child two and one quarter years old, Rotch,[1] by röntgen ray, shows the os magnum, unciform, lower epiphysis of the radius, cuniform, and semilunar present. The proximal epiphysis of the first phalanx of the little finger is faintly present; distal and proximal epiphyses of the fifth metacarpal are also faintly present. In the case here mentioned, there was total absence at two years of the fifth metacarpal, and no shadow of the distal or proximal epiphysis was present. There was present, however, the proximal epiphysis of the first phalanx of the fifth finger and the unciform bone. There was no attachment for the proposed bone transplant which was intended to replace the fifth metacarpal. The transplant, however, was placed for the following reasons:

(*a*) Although the röntgen ray picture showed no distal and no proximal epiphyses of the fifth metacarpal bone, normally they should be there but would give no shadow at two years of age.

(*b*) If they were congenitally absent, the proximal epiphysis of the first phalanx of the fifth metacarpal and unciform bones which were present were the goals for contacting the ends of the transplant.

(*c*) It was either amputation or a trial at bone transplant. This case was operated a week ago.

3. *Retention of position in scoliotic spines and bone transplants.* The retention of the scoliotic spine in a corrected or over-corrected position is a problem which many who are vexed with the question of the treatment of these cases are concerned. Some think that probably the bone transplant along the spinal column into the spinous processes, as is done for the support of the tuberculous spine, would prove successful. The difficulties which present themselves in this work are:

(*a*) The correction of the curve, in the severe cases, into a position for the transplant. In the mild, flexible cases such satisfactory results are obtained by corrective corsets and exercises that operative fixation is needless.

[1] Rotch, Röntgen Ray in Pediatrics, Plate 31.

(*b*) Even when partially corrected (and this is probably all one may confidently expect in the stiff cases), the spinous processes of the rotated vertebræ are not, as in Pott's cases, lined up evenly, but the entire vertebræ are bent to the side, and each spinous process twisted out of line in such a manner as to make the placing of the transplant between the split surfaces of the posterior spines extremely difficult. Yet animal experimentation encourages more work along this line with hope of better results from operative methods than those obtained by Hoke [1] or Le Breton.[2] The latter made sections of some of the ribs close to the spine, and of a part of the erector spinal group in the apex of the curve, and division of several of the ligaments, but with doubtful results.

4. *Replacing resected tuberculous joints with bone transplant.* Replacement of resected tuberculous joints with bone taken from the patient's tibia often becomes a procedure forced upon the operator with only one alternative, amputation of the limb. Experience shows that in resection of the knee-joint, for instance, the case is often too far advanced, the bone of the femur and of the tibia too extensively destroyed to allow apposition of healthy, firm bone with a fair possibility of ankylosis strong enough to give substantial support. Frequently several inches of both the femur and the tibia must be resected before the tuberculous material is thoroughly cleansed away, and many cases present themselves for treatment so late in the disease that the eradication of tuberculous material without amputation is never accomplished. Stiles [3] found that between 1901 and 1911 in the Royal Edinburgh Hospital for sick children there were sixty-three excisions of the knee in which twelve required subsequent amputation. Without opening up the question of earlier operative interference in selected cases of tuberculous joints, it seems only fair to call attention to the large number of neglected cases complicated with extensive involvement of the para-articular tissue, amalgoid disease, and advanced anæmia, with three possibilities. (*a*) Resection with doubtful results. (*b*) Resection with transplant. (*c*) Death from complications.

The literature gives an account of a case in which Streissler [4] transplanted two sections of bone to take the place of a knee-joint resected for tuberculosis. The case was one in which it was possible to cut away all the affected bone. There seems to be no case reported in which the transplant was placed in tuberculous material. As an example of a knee transplant in which the object was:

(1) To eradicate the disease if possible without amputation, and place the transplant in sound bone; but, (2) if impossible, to clean away all the diseased bone, then to transplant in the diseased bone, attempting to give a stiff leg, strong enough to bear the weight of the body, thus preventing amputation.

I report the following case:

A girl 16 years old, Austrian by birth, had been an invalid for four years, suffering pain and inability to go to work or school on account of a tuberculous left knee. She was a neglected case, and her only chance for comfort and working ability lay in extreme operative interference. E. Wyllys Andrews advised against amputation; he, however, agreed to resection, which was done, removing about three inches of the femur and about two inches of the tibia. The involvement, however, was so extensive that eradication of all the tuberculous material was impossible without amputation. This I refused to do for two reasons. First, the condition of the patient was now not favorable. Second, the prospect for transplanting later was promising for a good stiff leg instead of an artificial one. The wound, therefore, was closed, extension was applied, while a cast was placed to give proper support and maintain extension. This resection gave the patient great relief and her general condition began to improve. Three months after the resection, when her blood had improved, a second operation was performed, transplanting a large piece of the tibia from the opposite leg and implanting it so as to span the space between the tibia and the femur and firmly fixing it to these bones and to the patella.

The technique was as follows:

A longitudinal incision, fourteen inches long, was made in the midline of the anterior surface of the left thigh and leg, above and below the knee. The patellar ligaments were cut at the outer side and below, and the patella pulled to the inner side. The incision was carried down to the surface of the tibia and the femur. Two inches of the upper end of the

[1] Hoke, Tr. Am. Orth. Ass., 1903, xiv.

[2] Le Breton, Am. J. Orth. Surg., 1907, iv, 315.

[3] Stiles, Harold S. After-Results of Major Operations for Tuberculous Disease of Joints. Brit. M. J., 1912, 1364.

[4] Streissler. (Beitr. z. klin. Chir., 1910, lxxi, 1.)

tibia were sawed off, leaving a fairly healthy tibial surface. A wedge-shaped piece of the anterior surface of the tibia, one inch long, was now chiseled out to permit the graft, ten inches long, taken from the right tibia, to fit in and lock. A wedge-shaped piece of the lower end of the femur was also removed and some newly-formed bony tissue chiseled out to receive the upper end of the graft, but the bone here was soft, tuberculous, and unpromising for a transplant bed. Transverse drill holes were now made in one side of the lower end of the femur, in the upper end of the tibia, and through the ends of the graft to correspond. The bone graft was now fitted in place between the femur and the tibia and fixed by kangaroo tendon through the drill holes made in the femur, patella, and the tibia. All periosteum which was saved was sutured about the bone. The muscles were sutured together over the graft with catgut and the wound closed with silkworm sutures and dressed with dry gauze, pads, and sterile bandage. A plaster of Paris cast was now applied from the thigh to the toes.

For the removal of the transplant from the tibia a longitudinal incision was made over the crest of the right tibia, twelve inches long, down to the bone. For this part of the operation a fresh set of instruments was used.. The muscles were separated from the bone at its outer surface and a triangular graft from the crest of the tibia, ten inches long, was removed with its periosteum and the muscles were pulled over the denuded bone with catgut sutures, and the wound closed with silkworm. A plaster of Paris cast was applied from the knee down, enclosing the foot.

The progress of this case since the transplant was placed has been satisfactory. The patient improved in general condition. The wound healed by first intention, but later gave evidence of a slight discharge of serum, containing a few polymorphyler leucocytes and some scattered cocci. This soon cleared up and both wounds are closed and look resistant and healthy. The patient is up and about with crutches, forbidden, however, to bear weight on the leg. Röntgen ray pictures show the bed in the right tibia from which the transplant was taken is fast filling in, as is the case in a series of twenty-seven legs from which large grafts were taken for tuberculous spines, as reported in a paper entitled, "Spinal Transplant," read last month before the Chicago Medical Society.

The pictures of the transplant, placed with its upper end in the remains of a tuberculous femur, one side of which was too soft to hold a drill hole, and the lower end also lying in tuberculous material, show regeneration of bone taking place, with the lower end of the transplant well interlocked with the tibia and the upper end in good condition but somewhat atrophied. This bone support looks better at this time, six months after the operation, than I had anticipated, in view of the decayed condition of the femur at the time of the operation.

An interpretation by Adolph Hartung, of the röntgen ray lantern slide, is as follows:

"The anteroposterior view of the plate shows an absent area about the knee joint at the lower portion of the femur and the upper part of the tibia. Extending between the ends of these two bones and into their medullary canal for a distance of about one inch is a splint having the consistency of solid bone and tapering somewhat at its upper end. Around this upper end some rarefaction has occurred in the femur, uniform on its outer but irregular on its inner aspect. Well defined calcareous deposits extend from the margins of the resected femur and tibia. Along the lower end of the splint they seem to encircle it fairly uniformly up to the head of the fibula. The fibula is entirely intact and normal in appearance. The patella is indistinctly outlined and apparently covered by overlying shadows of calcareous material, of which there is a good deal to be seen throughout the joint area.

"The lateral view shows much the same picture except that here the patella seems intact and directly in contact with the bone splint. The upper end of the splint is very near the anterior aspect of the femur. Considerable calcareous deposit is seen behind the splint and also around its lower end."

SUPERNUMERARY URETER OPENING EXTRAVESICALLY

By HENRY DAWSON FURNISS, M. D., F. A. C. S., New York City

SUPERNUMERARY ureters emptying into the bladder are often seen, but a supernumerary ureter opening extravesically is a rarity, and because of this, its clinical importance, and the fact that there is generally a failure to properly diagnose the condition, I report my case.

N. M., a girl of twenty years, referred by Dr. A. R. Stern. Her menstrual history was negative, and she had never been pregnant. As long as she can remember she had been wet with urine, day and night, and yet voids normally once or twice a day. Neither exertion nor rest has any effect upon this condition. The patient is well formed, shows no stigmata of degeneration, nor abnormalities of the genital organs.

The condition was suspected from her history, which was characteristic; i. e., constant discharge of urine since birth in addition to normal voiding.

The examination was made with the idea of finding an abnormally opening ureter and was conducted as follows:

Ten ccm. of three-tenths of one per cent solution of indigo-carmin was injected intravenously and the patient then cystoscoped. A normally situated ureter excreting urine in a normal manner was found on either side; no vesical lesions nor malformations were noted in the external orifice of the urethra. The whole urethra (with the Kelly speculum) and the entire vagina, with the patient in the knee-breast posture, was then inspected without discovering the source of the leakage.

Still being convinced that the condition was as at first suspected, I plugged the vagina with wet cotton tampons, put wet cotton applicators in the urethra extending just to the vesical sphincter of the urethra, and a pledget of wet cotton over the vestibule of the vagina. After waiting fifteen minutes these were removed, and it was found that the cotton over the urethral orifice was stained faintly blue while the ones from the urethra and vagina showed no discoloration.

Close inspection failed to show the ureter until the patient strained in moving, when there was a discharge of a few drops of fluid from a minute orifice in the median line just at the lower edge of the urethral opening. A No. 6 ureteral catheter could be introduced only two inches, running slightly to the left. From this was obtained in ten minutes ℥ii of a faintly bluish colored fluid of a low specific gravity. The specific gravity was not taken, nor was an estimate of the urea percentage made.

It would have been interesting to have injected all three ureters with collargol and to have radiographed the patient to see their relations to each other and to the kidney pelves, but this was abstained from, as it would have been of no benefit to the patient, and we ran the danger of causing infection, ureters opening extravesically being especially susceptible.

Operation. On June 28, 1913, in the Post-Graduate Hospital, under ether anæsthesia, the supernumerary ureter was catheterized for four inches with a ureteral catheter. Using this as a guide, an incision was made over it on the under surface of the urethra, but unfortunately the incision went into the ureter itself, which was thin-walled and dilated to the size of a large lead pencil. This dilatation involved only the distal one inch of the ureter. Thinking that the whole ureter would possibly be dilated, and that I would have great difficulty in dissecting it out, I then put through the urethra a uterine sound which was made to bulge the bladder just over this ureteral sac. An opening between this sac and the bladder was made, and the mucosa of the ureteral sac and the mucosa of the bladder sutured together. Next the floor of the ureteral sac and the external orifice of the ureter were closed with fine catgut, thus producing a fistula between the bladder and the ureteral sac into which the ureter emptied.

The vagina was closed over this with sutures of silkworm gut. A retention catheter was put into the bladder, and removed on the fourth day; up to this time there had been no leakage, but following the removal of the catheter, the patient had the same leakage as before the operation.

Because of this failure the patient was operated upon again on July 11th. The silkworm gut sutures were removed and it was found that the leakage occurred from the posterior end of the incision. To gain better access to the ureter a pararectal incision was made through the left sulcus of the vagina; a catheter was then passed into the ureter and the ureter dissected out for an inch and a half. I was surprised to find how easily this was done and to see how thick the ureter really was, being here the size of a goose quill. A uterine sound was then passed through the urethra and made to bulge the bladder just behind and to the inner side of the normal opening of the left ureter. A small incision was made on the point of the sound which was then pushed into the vagina. A suture was passed through one lip of the ureter, tied to the sound, and in this way the ureter was pulled into the bladder for a distance of three quarters of an inch. This suture was withdrawn through the urethra and with a needle was anchored just outside of the clitoris. One fine suture of plain catgut was passed through a portion of the muscular wall of the ureter and the opening into the bladder, and the vagina closed over this with interrupted sutures of catgut. A retention catheter was put into the bladder for four days.

Following this operation there was not a bit of leakage, but the patient experienced frequent and painful urination due to a rather severe cystitis, which lasted ten days, but was cleared up by irrigations with nitrate of silver solution.

Two days following the second operation the patient had a rise of temperature and pain in the region of the left kidney. The temperature quickly subsided, but since then there has been more or less pain in the renal region.

An examination on August 1st with the cystoscope shows the ureter that was implanted as a small round opening just behind, and to the inner side of, the normal ureter. I have been unable to catheterize this on account of its minuteness; and after an intravenous injection of indigo-carmin I have seen no elimination of the dye from it. There seems to be a periodical discharge of small amounts of clear fluid, though of this I am not certain.

In most of the reported cases, as in mine, the following conditions were noted:

Minute orifices: In ureters opening just below the urethra this has been described by all except Olshausen as a very minute round orifice, and generally the location has been just on the margin of the external orifice of the urethra.

In Olshausen's case this orifice was described as "slit-formed." These orifices are very difficult to discover, even when directly under the eye, and are best seen after giving the patient methylene-blue or indigo-carmin to render the urine blue.

Sac formation; In most of the cases this has been noted just back of the contracted orifice, but this as a rule involves only the terminal portion of the ureter. The difficulty in catheterization is due to the trouble in making the catheter enter the ureter at the kidney end of the sac.

Impaired function; This is most probably due to the back pressure atrophy caused by the contracted orifice of the ureter. This has been noted in most of the cases as evidenced by the light color, low specific gravity of urine with small urea content, and deficient elimination of phenolsulphonephthalein and indigo-carmin.

Tendency to Complications; This is noted in many cases of supernumerary ureter, and when they open extravesically it is increased. Infection after instrumentation because of the poor drainage due to the contracted orifice is the most usual complication. Cessation of function was apparent in my case, but not noted in those reported by the authorities mentioned below. This cessation probably came from the contraction of the vesical orifice of the ureter.

Diagnosis. From the history of incontinence since birth with normal voiding of urine, an abnormal opening of the ureter should be suspected.

If by inspection the orifice of the ureter is not seen, indigo-carmin, methylene-blue or phenolsulphonephthalein should be given, and the vagina and vulva packed with cotton. If phenolsulphonephthalein is used the cotton should be wet with an alkaline solution to bring out the color; after fifteen to twenty

minutes the cotton is removed and the stained portion will give a clue to the point of the opening of the ureter.

Cystoscopy will show whether the extravesical ureter is supernumerary, or the only one from the kidney.

Many operations have been proposed for this condition, such as ligation of the ureter, establishment of a fistula between the sac-like portion of the ureter and bladder, implantation of the ureter into the bladder either through the vagina or abdominally, both intra- and extra-peritoneally, partial nephrectomy, removing the portion of the kidney drained by the supernumerary ureter.

From a study of my case and those reported in the literature, I believe the vaginal implantation the procedure of choice.

To determine just how this should be best done, I shall in the future attempt to catheterize the two ureters on the side affected with different kinds of X-ray bougies and have stereoradiographs made. By determining the relation of one to the other, the operation can be so planned that they will not be twisted around each other.

For those desiring to review the literature of the subject, I refer them to:

Adrian & A. V. Lichtenberg, Ztschr. f. Urol. Chir., 1913, i, Nos. 2 and 3. Die Klinische Bedeutung der Missbildungen der Niere, des Nierenbeckens und Harleiters.

Joh. Hartman[1] of Leipzig, reports from the literature:

Sixteen certain cases of supernumerary extravesical ureters, twelve uncertain cases of supernumerary extravesical ureters and seven cases of single ureter opening extravesically.

J. P. Hartman, of Copenhagen,[2] reports nineteen cases of supernumerary ureters opening extravesically, operated upon by various surgeons after the following methods:

	No.	Successful	Unsuccessful
Ligation	1	0	1
Ureterocystotomy			
Intravesical	2	2	0
Vaginal	5	0	5
Implantation			
Laparotomy	3	2	1
Abdominal extraperitoneal	1	1	0
Vaginal	6	4	2
Resection of Kidney	1	1	0
	19	10	9

He also gives the following analysis of thirty-seven cases of ureter opening extravesically, fourteen of which are supernumerary ureters:

Opening in the	No.	Single ureter	Supernumerary
Urethra	6	3	3
Vagina	8	5	3
Vestibule	21	11	8 (2?)
Gartner's Duct	2	?	?

[1] Ztschr. f. Urol., 1913, vii. 429. Zur Casuistick und Operative Behandlung überzalige aberanter Ureteren.

[2] Ztschr. f. Gynäk. Urol., 1912, iv, 69.

THE INFLUENCE OF ECTOPIC PREGNANCY ON THE UTERUS, WITH SPECIAL REFERENCE TO CHANGES IN ITS BLOOD SUPPLY AND UTERINE BLEEDING[1]

Based on the Study of 25 Injected Uteri Associated with Ectopic Pregnancy

By JOHN A. SAMPSON, M. D., Albany, N. Y.

THE purpose of the present article is to show the influence of ectopic pregnancy on the uterus, with special reference to the changes in its blood supply and the etiology of the uterine bleeding due to this condition. The latter is an important symptom, which is usually present in these cases when the physician is first called to see the patient.

The material for this study consisted of twenty-five uteri associated with ectopic pregnancy which were removed at operation, and as a matter of routine injected soon afterwards.

Dr. Richard R. Smith, in 1911, presented before the American Gynecological Society a paper entitled "Repeated Ectopic Pregnancy, with a Report of Four Cases and a Statistical Review of the Literature."[2] He concludes that "normal pregnancies following ectopic pregnancy are not as frequent as one might hopefully suggest, and that the practical lesson to be drawn from this discussion of repeated ectopics relates to the disposition of the opposite tube at the time of the operation. The strong tendency of the last decade toward conservation of the pelvic organs has resulted in the saving of the opposite tube with most surgeons unless it is diseased. Is this conservation based on logical grounds? It is my opinion that we must modify it. The common basis for decision has been the condition of the tube under judgment, and a little thought will show this to be unreliable. In very many of the reports in which its condition is mentioned it is spoken of as normal. It must be frankly acknowledged that we are unable to judge of the capabilities of a tube from its appearance. Shall we not rather consider the woman's condition relative to age, previous child bearings, her health, her wishes, and the danger lurking in the tube that is left, whatever its appearance. I would suggest that the matter of future possibilities be freely discussed, so far as practicable, with each patient before the abdomen is opened, and would suggest the following outline of procedure:

"1. If a woman has had no children and is young, or, being older, is desirous of having children, we should conserve the opposite tube unless it is hopelessly closed. We do this deliberately, with the full knowledge that further pregnancies may not occur and that she may have, in spite of the normal appearance of the tube, a further ectopic.

"2. In women who have borne children, we may be governed by her desire to have more, and may leave it unless it is absolutely closed.

"3. In women who have had children and have borne as many as they desire, we should unhesitatingly remove the opposite tube and preclude the possibility of further accident, whether the tube appears normal or not.

"By following this course we should at least have a good excuse for submitting a woman to the distressing possibility of a second ectopic pregnancy."

For the last four years I have been following a procedure similar to the one outlined by Smith, and my own experience has justified this procedure. Previous to 1905 I had operated upon eleven cases of ectopic pregnancy in the service of Dr. Howard A. Kelly, of Baltimore, and know nothing of the future of these cases, but in only five was a subsequent pregnancy possible, both tubes or the uterus and tubes having been removed in the other six.

Since coming to Albany, in 1905, I have operated upon forty cases of ectopic preg-

[2] Tr. Am. Gynec. Soc., 1911, xxxvi.

[1] Read before the American Gynecological Society, May, 1913.

nancy. In only eleven was a future pregnancy possible, the uterus having been removed in twenty-six, and future conception made impossible by the removal of both tubes in one, the only remaining tube in another, and one having died soon after the operation. The subsequent history of these eleven patients is of interest, especially as the opposite tube was carefully examined in nine of them and was apparently normal; and was saved with the hope of subsequent uterine pregnancy. In two the condition of the patients was so grave at the time of the operation that the opposite tube was not examined. Five of the eleven patients have not conceived since the operation (less than six months has elapsed since the operation in two of them). Of the other six patients two have borne children; one has had two children since her operation, and another has had one; the latter has subsequently had a tubal pregnancy in the remaining tube. Three have had miscarriages, one has had four, and two have had one each. The sixth has had a tubal pregnancy in the opposite tube. Therefore, two of the six have had a tubal pregnancy in the opposite tube; one, as already stated, was preceded by a uterine pregnancy. In addition I have encountered two other cases of tubal pregnancy in which the opposite tube had been removed for a similar condition by another surgeon.

My own experience conclusively proves that when we do not remove the opposite tube, even though it appears normal, when operating for tubal pregnancy, the patient may subsequently have a pregnancy in that tube.

In spite of the dangers of repeated ectopic pregnancy, I believe that the chance of subsequent pregnancy should, if possible, be preserved in women who are desirous of having children or should have them irrespective of their own wishes. While the discussion of future possibilities with patients before operating has certain drawbacks, it also has certain advantages, and I believe the latter outweigh the former. It is true that the patient may live in fear of a subsequent tubal pregnancy and at times become very apprehensive. There is the decided advantage, however, that if it does take place the patient immediately consults a physician and, in fact, may herself make the correct diagnosis, as occurred in two of the four cases of repeated tubal pregnancy I have seen. But why remove the uterus? I do not consider that it is usually good surgical judgment to remove both tubes and leave the uterus in a patient who may previously have had a pelvic infection or may have pelvic adhesions after the operation. The possibilities of trouble subsequent to a hysterectomy are less than after a bilateral salpingectomy, and the added danger in nine-tenths of the cases is not appreciable. There was only one operative mortality in the fifty-one cases and that followed a unilateral salpingo-oöphorectomy.

Methods of preserving and studying the material.—The injection mass used was fifteen per cent gelatin, which contained in suspension either a pigment or some material (usually bismuth subcarbonate) which is impervious to the X-ray. The methods of injecting, preserving, and studying the specimens were similar to those described in my paper "The Blood Supply of Uterine Myomata."[1]

Photographs were made of cross or sagittal sections of the more interesting uteri where pigment was used in the injection mass and radiographs were made of cross "slices" of the uteri injected with bismuth. The contents of all the tubes, the seat of an ectopic pregnancy, were examined microscopically. From three to six "blocks" were taken from different parts of the uterine wall, including the mucosa, and examined microscopically in order to ascertain the exact condition of the myometrium and endometrium in different parts of the uterus, and microphotographs were made of many of these.

The pregnancy in all the twenty-five cases was situated in the tube, the right tube being involved in nineteen and the left in six. Only one was of the interstitial variety. Ten definitely arose in the ampulla of the tube and four in the isthmus. In the remaining ten it was difficult to determine the exact part of the tube in which the pregnancy first developed, on account of the general distention of the greater portion of the tube. From their

[1] Surg., Gynec. & Obst., 1912, xiv, 215.

appearance it would seem that in the majority, if not in all of these ten, the pregnancy first developed in the ampulla. Tubal abortion was present in sixteen and rupture in eight, and in one (the one arising in the interstitial portion of the tube) the cornu of the uterus was about to rupture.

I regret that I am unable to present a complete study of this problem, as all the stages of ectopic pregnancy were not encountered in this series, and some of the most important ones were absent. In all of my cases the termination of the pregnancy had begun before I saw the patient, and the shortest time that had elapsed, from the onset of these symptoms until the day of the operation, was three days, and the largest fœtus found was only 6 cm. long.

All of the uteri in this series were studied with a knowledge of the clinical history of the case (not complete in every case).

The most important data in studying the influence of ectopic pregnancy on the uterus are: first, the age of the ectopic gestation when the termination of the pregnancy began; second, the time that had elapsed from the onset of the termination of the pregnancy until the operation, and, if completely terminated, the date of the last severe attack of pain; third, the condition found within the pregnant tube, and especially whether the products of conception were still present or not, and, if present, what they were; fourth, whether or not uterine bleeding had been present, and especially, if present the day of the operation. Other data are of interest, such as the age of the patient, her menstrual and marital history, the situation of the ectopic pregnancy, and the method of termination (whether by tubal abortion or rupture) and associated conditions, but all these are of secondary importance to those just mentioned.

The age of the ectopic gestation is difficult to determine even when the embryo or fœtus is found if several days have elapsed since the beginning termination of the pregnancy, because its growth might cease at that time, or it may even become smaller (some are apparently entirely absorbed), or if it continued to grow its rate would probably be retarded. The menstrual history is often of very little value in deciding this point, as in many instances the patient had not missed her menstrual period. The size of the tube may be misleading as an index of the age of gestation, as it depends upon several factors, the most influential of which is the amount of hæmorrhage into the lumen of the tube and the ease with which it escaped into the peritoneal cavity. There was not any evidence, in this series, of the blood in the tube escaping into the uterine cavity. I have attempted to determine the age of ectopic pregnancy from all the available factors in each case, relying for the most part on the conditions found within the tube. The embryo or fœtus was found in six cases, and five of these were still within the tube. The length of five of these was as follows: 3 mm., 4 mm., 1.2 cm., 4 cm., and 6 cm.; the sixth was 2.6 mm. in cross section (accidental finding in a stained section). The gestation sac was found in the tube in five other instances without any evidence of the embryo in the tube, the latter having been absorbed or expelled. The greatest diameter of each of these five sacs was as follows: 1 cm., 1.4 cm., 1.5 cm., 1.8 cm., and 2 cm. In ten specimens chorionic villi were found, but the embryo or gestation sac was not seen; in the four remaining cases no trace of the ectopic pregnancy was found other than the clotted blood. The five gestation sacs without embryos, the largest of which had a diameter of only 2 cm., and the three smallest embryos found in sacs having diameters of 1.2, 2, and 3.5 cm., have led me to believe that the termination of the tubal pregnancy in these eight cases probably began within the first month, and I believe that the majority of the others also terminated early, the most advanced pregnancy containing a fœtus only 6 cm. long.

The time that had elapsed since the onset of the termination of the pregnancy is based on the date of the first attack of pain, which is usually preceded by, associated with, or soon followed by uterine bleeding. Both symptoms were present in all but one of these cases, and in the majority of them more or less constantly until the operation. One

would expect that the condition of the uterus would change with the length of this time, and this was found to be true. Only two of the patients were operated upon within the first week of their acute illness, three between one and two weeks, three between two and four weeks, fourteen between four and eight weeks, and three after eight weeks. The longest time that had elapsed since the onset of symptoms suggesting the beginning termination of the pregnancy (pain and uterine bleeding) was seventy-two days; this patient was confined to her bed the greater part of this time, and uterine bleeding continued more or less constantly throughout the time and was present the day of the operation. The termination of the pregnancy in this instance was incomplete, a gestation sac 3.5 cm. in its longest diameter was still in the tube, and what appeared to be the remains of the embryo, 4 mm. long, within this sac.

In the case of the interstitial pregnancy the cornu of the uterus was about to rupture (see Case 25), and the gestation sac was still present, surrounded by blood, but no trace of the embryo was found. In twenty-one of the twenty-five cases of tubal pregnancy, as already stated, some of the products of conception were found within the tube. In these twenty-one cases the termination of the tubal pregnancy was *incomplete* in the fullest sense, although four weeks or more had elapsed in seventeen of them since the termination began and over eight weeks in three. In four cases no trace of the embryo or gestation sac were found within the tube. One of these had terminated by tubal abortion, and in the manipulation of the tube at the time of the operation a bloody mass was expressed from the fimbriated end of the tube, which was lost. In the remaining three the pregnancy had terminated by rupture and the tube was badly torn. Still in these three the apparent completion of the termination of the pregnancy may have been accomplished by the manipulation of the tube at the time of the operation, and, furthermore, the fact that chorionic villi were not found does not prove that they were not there, for the entire tube was not examined microscopically. My own studies (based on only twenty-five cases) have led me to believe that the *termination of the pregnancy is rarely complete* in the full sense of the term when the patient is operated upon, and as long as it is incomplete attacks of pain and uterine bleeding may occur.

Twenty-four of the twenty-five patients gave a history of uterine bleeding, usually inconstant and associated with attacks of pain. The only one which did not give a history of uterine bleeding showed intact decidua formation of the endometrium and a fœtus 6 cm. long in a tube with a small opening in its upper surface through which chorionic villi protruded. In some the uterine bleeding preceded the pain and in others a severe attack of pain was the first indication of the beginning termination of the pregnancy. The exact relation between the two was not ascertained in all the cases. In all but three of the specimens some of the venous injection mass escaped from the endometrium into the uterine cavity and out the cervix when the specimen was injected, and in no instance did any of the arterial mass escape. *The uterine bleeding in all these cases was of venous origin and arose from the endometrium, and in not a single instance did it escape from the tube into the uterine cavity.*

The associated tubal and ovarian conditions presented some unusual features. In one instance the pregnant tube communicated with the sigmoid through the fimbriated extremity, and, aside from pain, attacks of bleeding from the rectum was the most marked symptom the patient had (see Case 23). In another case a necrotic parovarian cyst, 13 cm. in diameter, with a twisted pedicle, was present in the opposite ovary (see Case 4). Retention cysts of the ovary were present in six instances, in two cases bilateral. I do not understand the significance of their occurrence. The definite results of previous pelvic inflammation were encountered in nine, a tubo-ovarian abscess once, a pyosalpinx once, hydrosalpinx once, bilateral tubal tuberculosis once, and in the remaining five old adhesions about the opposite tube and ovary. In eight instances the opposite tube and ovary appeared normal.

THE BLOOD SUPPLY OF THE NON-PREGNANT UTERUS

I have already described certain features of this in two previous articles.[1] In connection with the study of the present subject, I wish to again briefly describe the blood supply of the uterus with special attention to that of the endometrium, concerning which I have learned more since writing the previous articles.

The course of each uterine artery along the side of the uterus and its free anastomosis with the ovarian of the same side are well known. From each uterine artery branches arise, at intervals, which penetrate the uterus. These branches, which I have called arcuate arteries, pass between the outer and middle third of the anterior or posterior uterine wall, and each one supplies a quadrantal segment of the uterus, corresponding to a segment of either the anterior or posterior half of the Müllerian duct of that side. They terminate in median (peripheral) and radial (centripetal) branches. The peripheral terminal branches of some of the arcuate arteries of one side anastomose freely with similar branches of the corresponding arcuate arteries of the opposite side, thus establishing a free arterial communication between the two uterine arteries. Along the course of each arcuate artery peripheral (centrifugal) and radial (centripetal) branches arise. The peripheral branches nourish the peripheral portion of the myometrium, and the latter the remainder of the myometrium and the endometrium. The arterial system of the uterus enables us to divide the uterus into three zones: first, the peripheral (the outer third), which is nourished by peripheral arteries; second, the arcuate, the narrow (boundary) zone in which the arcuate vessels lie, and, third, the radial (the inner two-thirds, including the endometrium), which is nourished by radial arteries.

All the intrinsic uterine arteries pursue a spiral course, which is apparently a provision for the changes in size of the uterus and uterine contractions. There are free anastomoses between some of the branches of the peripheral arteries. On the other hand the terminal branches of the radial arteries appear to be end arteries. When an arterial injection mass was used of sufficient coarseness so that it would not escape into the veins, I found that while the radial arteries terminated in the endometrium this tissue appeared to be poorly supplied with arterial blood, as vessels containing the injection mass extended into it for only a short distance. On the other hand the examination of the endometrium with the higher powers of the microscope showed that arterioles with lumina too small to receive the injected mass were present. These arterioles or large capillaries seemed most abundant in specimens obtained during the premenstrual stage of the menstrual cycle and extended to the compact layer and tissues beneath the epithelium lining the uterine cavity. (See description of the uterus in early uterine and ectopic pregnancy.) In many specimens these arterioles were apparently very few in number or difficult to detect, and this seemed to be particularly true of patients operated upon in the post-menstrual and interval stages of the menstrual cycle.

The venous system is as follows: first, a rich plexus of the endometrium which is fed by the terminal branches of the radial arteries; second, a similar but larger plexus of the myometrium which communicates with that of the endometrium by venous channels. About the periphery of the myometrium, especially on the sides and sometimes accompanying the arcuate arteries, are collecting veins which convey the venous blood to the uterine veins between the layers of the broad ligament.

The arteries of the myometrium have distinct walls, and these become physiologically sclerotic as the individual becomes older, and furthermore there is a temporary thickening of some and destruction of others in the process of involution following childbirth. When studying the arteries of the myometrium we must not only know the age of the patient, but if she has not yet reached the menopause whether or not she has had children, and if she has, the date of the last childbirth.

The veins, except the collecting veins of the myometrium, are for the most part lacking in

[1] The Blood Supply of Uterine Myomata, Surg., Gynec. & Obst., 1912, xiv, 215, and The Influence of Myomata on the Blood Supply of the Uterus, Surg., Gynec. & Obst., 1913, xvi, 144.

distinct walls, *i. e.*, there are merely spaces lined by endothelial cells between the bands of muscle fibers.

The arteries in the base of the endometrium have distinct walls, and the fine arterioles with lumina so small that they cannot be injected with bismuth or other granular pigments, also have distinct walls, and they pursue a spiral course, as the arteries in the myometrium. On the other hand the venous plexus of the endometrium, as in the myometrium, is composed of spaces in the stroma, lined by endothelial cells. As there are not any valves in the uterine veins, the muscular efficiency of the uterus must play an important part in regulating the amount of blood in these spaces and the control of the same.

Just before the menstrual flow the endometrium is thickened and the glands are hypertrophied, and there is often a distinct compact layer which may resemble the decidua of early uterine pregnancy. In addition the arterioles are more evident and apparently more numerous. The venous spaces are also dilated. Following the menstrual flow the endometrium becomes thinner, the compact layer is less evident, the glands are smaller, and the arterioles are more difficult to detect and apparently fewer in number and smaller.

The premenstrual stage suggests the arterial invasion of the endometrium with the evidence of increased functional activity, as in early pregnancy. Menstruation, on the other hand, suggests "labor" and apparently is followed by a process of involution which differs in degree from the involution following the birth of a child, and one of its most important features is a diminished arterial supply, and this is possibly an early step in the process of its involution.

THE BLOOD SUPPLY OF THE UTERUS OF EARLY PREGNANCY

The uterus is increased in size, and this is due to several factors: first, the pregnancy within the cavity; second, arterial and venous hyperæmia, and, third, the muscle fibers are probably larger.

As the present study of the changes of the uterus in early uterine pregnancy was undertaken for comparing it with the changes in ectopic pregnancy, the description of the changes in the endometrium will be confined to the decidua vera.

The decidua vera resembles the endometrium of the premenstrual stage of the menstrual cycle, except it is further developed, and this is apparently due in a large measure to its increased arterial supply. Sometimes it is very difficult to distinguish between the premenstrual endometrium and the decidua vera of early uterine pregnancy, especially as in very early pregnancy typical decidual cells are absent.

The endometrium of early pregnancy (Figs. 6 and 7) is thickened and may be divided into a compact and a glandular or spongy layer. The compact layer contains many arterial capillaries, about which the decidual cells apparently first develop. Venous spaces are also present in the compact layer, and especially at its junction with the spongy layer. The spongy layer owes its appearance to the hypertrophied uterine glands, and in places there is very little stroma between the glands. On the other hand trabeculæ are found scattered through the spongy layer, which unite the compact layer with the myometrium. These trabeculæ consist of stroma and contain the terminal branches of the radial arteries whose arterioles are found in the compact layer. The arterial trabeculæ, as I have called them, are much more distinct, and their arteries are much larger than in the non-pregnant condition. The arterial injection mass, which in the non-pregnant condition usually extends only a short distance in the endometrium, is quite frequently found in the arterioles of the compact layer of the pregnant uterus. The arteries pursue a spiral course in the trabeculæ, so that a longitudinal section gives the appearance of several vessels instead of one. There is often a decidual reaction of the stroma about the arteries in the trabeculæ. The development of the compact layer with its increased arterial supply and the presence of the arterial trabeculæ uniting the compact layer with the myometrium suggests that the changes in the decidua vera due to pregnancy are in a large measure dependent upon the invasion of its

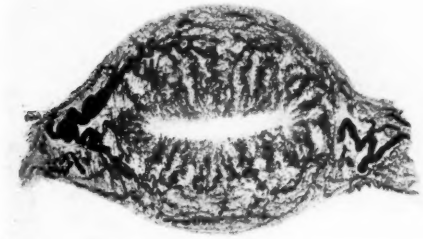

Fig. 1. Arterial supply of the uterine tissues. Radiograph (X 1) of a cross slice (3 mm. thick) of the body of the uterus. Nullipara, aged 34; arteries injected with bismuth; uterus removed for chronic pelvic peritonitis. For detailed description of the arterial supply of the uterus, see text. The radial arteries, *i. e.*, the centripetal branches of the arcuate arteries, are distinct, and the radiograph does not suggest any arterial sclerosis. Compare with Fig. 29.

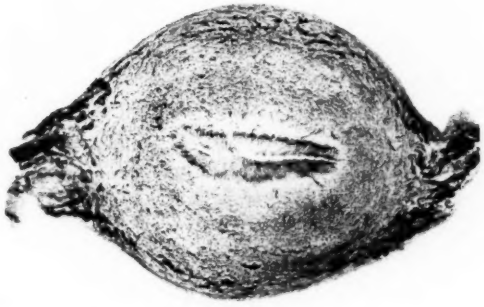

Fig. 2. Venous supply of the uterine tissues. Radiograph (X 1) of a cross slice of the body of the uterus, as in Fig. 1. Nullipara, aged 30; veins injected with bismuth through the uterine and ovarian veins. Uterus removed for chronic pelvic peritonitis in the latter part of the interval stage of the menstrual cycle.

For detailed description of the venous supply, see text. There is a rich venous plexus in the endometrium and the myometrium, and as there are not any valves in these plexuses, an intact endometrium and a tonic condition of the uterine muscle are important factors in preventing bleeding into the uterine cavity.

tissues by arteries through these trabeculæ. Venous spaces are found everywhere in the endometrium in the compact layer and the junction of the two layers, as well as in the arterial trabeculæ and the stroma between the glands.

THE INVOLUTION OF THE UTERUS AFTER ABORTION

Bearing in mind the structure of the decidua vera of early pregnancy with its compact and loose spongy layer, the trabeculæ containing spiral arteries which cross the latter and terminate in the former, and the venous spaces, especially those in the peripheral portion of the compact layer and at the junction of the latter with the spongy layer, we would expect that the violent contractions of labor (abortion) would impair the arterial supply of the compact layer and otherwise damage the structure of the decidua vera, especially at the junction of the two layers. We would expect this damage would lead to an extravasation of blood from the venous spaces, and the ones most readily injured would be those in the superficial portion of the compact layer and at the junction of the two layers. As a result of abortion the gestation sac, together with the embryo or fœtus, are expelled. If the abortion is complete, *i. e.*, all the products of conception are expelled, the uterus undergoes involution, *i. e.*, it becomes smaller, and the bleeding soon ceases. The involutionary changes in the decidua vera of early pregnancy are apparently similar to those following menstruation.

In a specimen from a young woman nineteen years old, whose uterus was removed for pelvic inflammatory conditions eight weeks after an abortion at the third month (her first pregnancy), I found that many of the radial arteries and their branches were markedly thickened and some of the branches were completely thrombosed. The latter changes were most evident in the branches just beneath the endometrium. The changes in the radial arteries, and especially in the branches supplying the endometrium, led me to believe that these are an important factor in the process of the involution of the endometrium.

If the abortion is incomplete, *i. e.*, some of the products of conception are still retained in the uterus, the uterus remains enlarged, uterine bleeding often occurs, and we speak of the condition as one of subinvolution, which is clinically relieved by the complete removal of the products of conception. It is interesting to note, as will be shown later, that the same

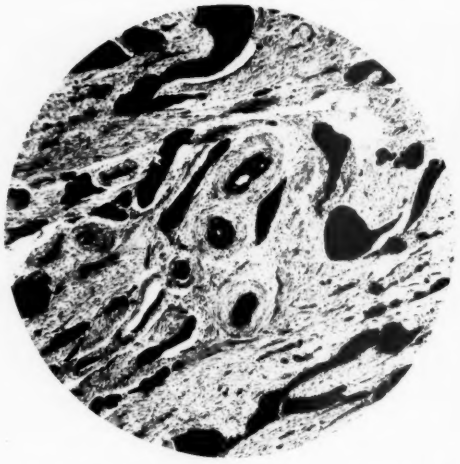

Fig. 3. The difference in the structure of the arteries and the veins of the myometrium. Photomicrograph (X 20) of a portion of the uterine wall. Arteries injected with Venetian red and veins with bismuth, both injection masses appear black in the photomicrograph. The arteries, easily detected, have distinct walls, while the veins (venous plexus) consist of spaces lined by endothelial cells between the bundles of uterine muscles. Distinct venous walls are apparently present only in the collecting veins, none present in this illustration.

Fig. 4. Structure of the endometrium in the latter part of the interval stage of the menstrual cycle. Photomicrograph (X 20) of a portion of the endometrium from the specimen shown in Fig. 2. The endometrium is thickened; glandular hyperplasia is present with an overlying compact layer. The venous plexus, shown in black, consists of spaces in the stroma of the endometrium lined by flattened (endothelial) cells. The picture suggests increased functional activity. The terminal arterioles of the radial arteries (seen with higher magnification) are more readily detected throughout the endometrium, including the compact layer, than in the section shown in the next illustration. The condition found resembles somewhat the decidua vera of early uterine pregnancy and the endometrium of early ectopic pregnancy (see Figs. 6 and 13). See also Fig. 27.

phenomenon occurs in tubal pregnancy. If the termination of the tubal pregnancy is complete (best seen after the removal of the pregnant tube), the uterus soon undergoes involution. On the other hand, if it is incomplete subinvolution takes place, the uterus remains enlarged, and the patient has attacks of uterine bleeding, often lasting several weeks (one of my cases over ten) after the beginning termination of the pregnancy. From this analogy I believe that in incomplete uterine abortion the retained products of conception still exert the influence of pregnancy as such upon the uterus and oppose the forces of involution, so that the latter process, started by the abortion, is retarded and subinvolution persists with its associated clinical phenomena.

REPORT OF CASES

CASE 1. Age 24, clinical data incomplete. Duration of the tubal pregnancy was probably two to three months, fœtus 6 cm. long in the tube. Operation three days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain, but no uterine bleeding. The pregnancy occupied the greater portion of the right tube and the fœtus, 6 cm. long, was still in the tube. The beginning termination of the pregnancy was by rupture through the upper wall of the tube, chorionic villi protruded through a small ragged opening about 5 mm. in diameter. While there was an extensive hæmorrhage into the peritoneal cavity, the fœtus was probably alive at the time of the operation.

The arteries were injected with Venetian red and the veins with ultramarine blue. The injected mass did not escape into the uterine cavity (uterine bleeding had not occurred). The uterus was enlarged to 6.5 x 5.3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus showed a marked dilatation of the venous plexus of the myometrium and endometrium. The

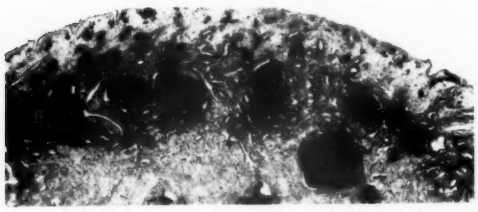

Fig. 5. Structure of the endometrium in the postmenstrual stage of the menstrual cycle. Photomicrograph (X 20) of a portion of the endometrium. Para, aged 27; uterus removed for chronic pelvic peritonitis, veins injected with bismuth. The endometrium is thin, glands small and apparently few in numbers, the deep venous spaces (black) are dilated. Arterioles are difficult to detect (seen with higher magnification). The picture suggests diminished functional activity in marked contrast to the condition shown in the preceding illustration.

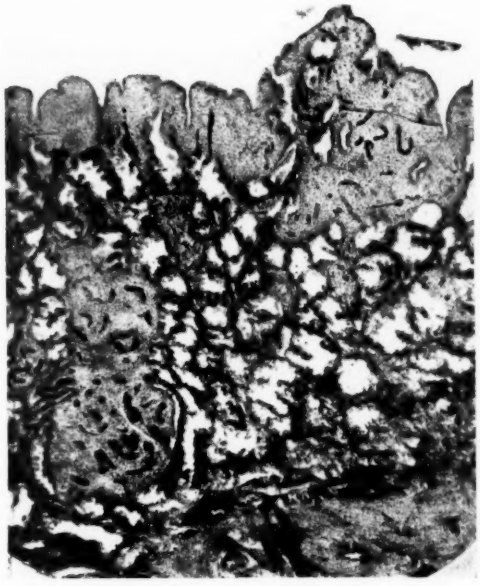

Fig. 6. The decidua vera of early uterine pregnancy. Photomicrograph (X 20) of a portion of the decidua vera. Nullipara (repeated abortions), aged 27. Uterus was removed for chronic pelvic peritonitis and an ovarian cyst. Pregnancy was an accidental finding, gestation sac, 2 cm. long, was found in the uterus, embryo not found. Arteries injected with Venetian red and veins with bismuth; both appear black in the photomicrograph.

There is a distinct compact and glandular layer. In the latter are trabeculæ (portion of one shown in the illustration) containing the terminal branches of the radial arteries. These trabeculæ convey arterial capillaries to the compact layer and unite it with the myometrium. The development of the decidua vera suggests increased functional activity and seems to be directly dependent upon the arterial invasion of the endometrium from the terminal branches of the radial artery, which pursue a spiral course and therefore a longitudinal section of one appears as several vessels. The degree of the development of the compact layer seems to be in direct ratio with its arterial supply. Notice the rich arterial supply in the thickest portion of the compact layer.

latter was greatly thickened (Fig. 11).[1] Microscopically the venous plexus of the myometrium was greatly dilated, the arteries were larger than normal, and no evidence of arterial sclerosis was found.

The endometrium was greatly thickened, .7 to 1.2 cm. Small arteries were apparently more numerous and larger than in the non-pregnant condition; these were most abundant in the spongy layer. The venous spaces were dilated, especially in the middle portion. The compact layer showed true decidua with dilated venous spaces, an occasional artery, and the ducts of the glands few in numbers and compressed; the stroma of this portion was everywhere infiltrated with round cells. In the spongy layer the stroma was dense, the venous spaces dilated, and glands few in numbers and atrophied.

The enlargement of the uterus with venous and arterial hyperæmia and the presence of a true decidua were all manifestations of pregnancy. The dilated venous spaces in the decidua and atrophy of the glands in the spongy layer were manifestations of beginning involution due to regressive changes in the endometrium.

CASE 2. Age 33, para, last uterine pregnancy fourteen months before. Tubal pregnancy probably early, less than four weeks (?), symptoms began ten days after a "normal menstruation" (see also description of the pregnant tube). Operation five days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation. The termination of the tubal pregnancy was by rupture and incomplete, as chorionic villi were found in the tube. The ampulla of the right tube was enlarged to 2.5 cm. in its greatest diameter. An irregular opening, 1 cm. in diameter, was present in its upper surface. Neither the embryo or gestation sac were found. A small cyst was present in the opposite ovary.

The veins were injected with bismuth. A small

[1] Fig. 11. (See frontispiece.) Hyperæmia of the uterus with decidua formation. Uterus of tubal pregnancy (fœtus 6 cm. long). Colored photograph (X 1) of a sagittal section of the uterus; arteries injected with Venetian red and veins with ultramarine blue. Fœtus 6 cm. long still present in the right tube (see Case 1). There was a small opening in the upper surface of the tube through which chorionic villi protruded, causing a free hæmorrhage into the peritoneal cavity. The fœtus was probably alive at the time of the operation, and the influence exerted on the uterus was that of pregnancy. Uterine bleeding had not yet begun. The entire endometrium has taken part in the formation of decidua.

Fig. 7. The decidua vera of early uterine pregnancy. Photomicrograph (X 20) from the same section shown in Fig. 6, a little to one side of the latter. The same arterial trabecula is shown. A large venous space (upper left-hand portion of section) is situated at the junction of the compact and spongy layer, and smaller ones are scattered throughout the endometrium, but especially in the above situation. The extravasation of blood from these spaces into the tissues of the endometrium would tend to separate the compact from the spongy layer.

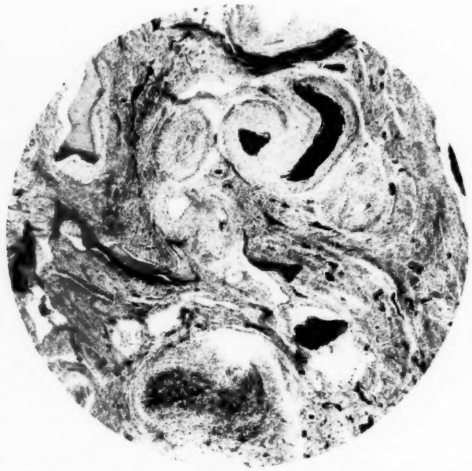

Fig. 8. Sclerotic and thrombosed branches of radial arteries following a uterine abortion. Photomicrograph (X 20) of a portion of the uterine wall. Patient aged 19; first pregnancy, abortion at the third month; hysterectomy two months later for pelvic inflammatory conditions. Arteries injected with bismuth and veins with ultramarine blue. Many of the branches of the radial arteries are sclerotic and some are thrombosed. I am unable to state the influence of the inflammatory process on the involution of the uterus. Apparently the process of involution following abortion is similar to that following full term pregnancy, differing only in degree. See next illustration.

amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the uterine wall and endometrium were well injected and dilated and the latter hypertrophied (Fig. 12). There was a slight degree of sclerosis of some of the radial arteries and their branches, probably due to previous uterine pregnancies.

The endometrium was hypertrophied, 3 to 5 mm., surface irregular and covered with epithelium. The compact layer was thin and contained areas of atypical decidua formation with marked dilatation of some of the venous spaces. The spongy layer showed marked glandular hyperplasia (Fig. 13). Arterioles were more evident than in the non-pregnant uterus (Fig. 14). Uterine bleeding arose from the rupture of some of the superficial dilated venous spaces (Fig. 15). The condition found in this specimen suggests that complete involution of the endometrium would have occurred without the expulsion of a decidual cast, as the uterine bleeding arose from the superficial venous spaces of the compact layer, and the latter was thin.

The hyperæmia of the uterus and presence of decidua were manifestations of pregnancy. The dilated venous spaces in the decidua and escape of blood into the uterine cavity were manifestations of involution due to regressive changes in the endometrium.

CASE 3. Age 34, para, last pregnancy three years before. Tubal pregnancy probably early, missed period for nine days. See also description of the pregnant tube. Operation ten days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, viz., pain and uterine bleeding, flowing slightly at the time of the operation. The termination of the pregnancy was by tubal abortion and incomplete. The ampulla of the right tube was enlarged to 3.5 cm. in its greatest diameter. The embryo was not found, but fragments of the gestation sac and chorionic villi were present in the tube. The opposite ovary contained a cyst 3.4 cm. in diameter.

The veins were injected with bismuth and a small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6.7 x 5.8 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed the

Fig. 9. Sclerotic radial arteries, uterus of ectopic pregnancy, but youngest child was only twenty months old. Photomicrograph (X 20) of a portion of the uterine wall. Patient aged 34, para, youngest twenty months, ruptured tubal pregnancy; the first symptoms of termination of the tubal pregnancy occurred thirty-four days before the operation. See Case 15. Many of the radial arteries were sclerotic; it is impossible to state whether as a result of the last uterine pregnancy or recent tubal pregnancy, but probably the former.

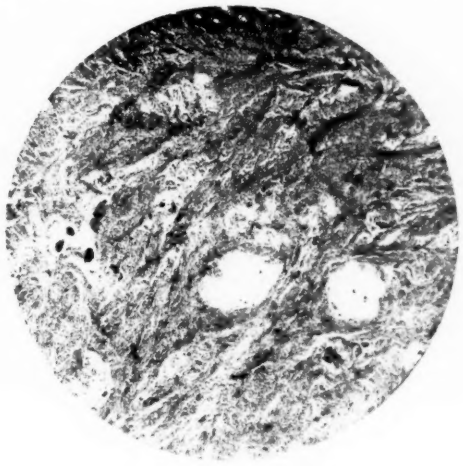

Fig. 10. Hyaline remains of sclerosed branches of the radial arteries, uterus of ectopic pregnancy, but youngest child was only eleven months old. Photomicrograph (X 20) of a portion of the uterine wall and endometrium. Patient aged 33, para, youngest eleven months old, tubal pregnancy on one side with tubal abortion and parovarian cyst with twisted pedicle on opposite. See Case 4. The hyaline areas are the probable results of the uterine pregnancy eleven months before.

venous plexus of both the myometrium and endometrium were well injected and that of the latter dilated (Fig. 16). There was a slight degree of sclerosis of some of the radial arteries. The endometrium (Fig. 17) was thickened, 3 to 4 mm., surface thrown into folds and covered with epithelium. The hypertrophy was due mainly to the dilatation of the venous spaces, especially in the distal portion (compact layer), which in places suggested atypical decidua. The glands were, for the most part, small; an occasional one showed hyperplasia. Arterioles seemed more evident than in the non-pregnant condition. The bleeding arose from the rupture of the superficial venous spaces.

The influence of pregnancy was still evident in the uterus, as shown by the thickened endometrium, decidua, and a few hyperplastic glands. The changes due to the early part of the regressive stage of involution predominated, namely, dilated venous spaces with escape of blood into the uterine cavity and atrophy of many of the glands of the spongy layer.

Case 4. Age 28, para, last uterine pregnancy eleven months before. Tubal pregnancy probably early, missed one menstruation, onset of symptoms two weeks later. See also description of the pregnant tube. Operation twelve days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, *i. e.*, pain and uterine bleeding, flowing at the time of the operation. The termination of the tubal pregnancy was by tubal abortion and incomplete. The left tube was distended with a blood clot (greatest diameter 4.2 cm.), in the center of which was a gestation sac 1 cm. in diameter, embryo not found. A parovarian cyst, 13 cm. in its largest diameter, was present on the opposite side; this was necrotic, due to twisting of its pedicle. It was impossible to ascertain the exact relation between the tubal abortion and twisting of the pedicle of the parovarian cyst.

The arteries were injected with bismuth and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the arteries had small lumina, due to the extensive sclerosis present.

There was a marked sclerosis of many of the radial arteries and their branches, probably due to the uterine pregnancy eleven months before. The endometrium was thin, 1 to 2 mm., surface in places rough but covered with epithelium. Compact layer was absent, glands small, stroma dense, arteries small and difficult to detect, venous spaces dilated, no decidua, bleeding arose from the venous spaces. The influence of the ectopic pregnancy on the uterus had disappeared except for a retardment

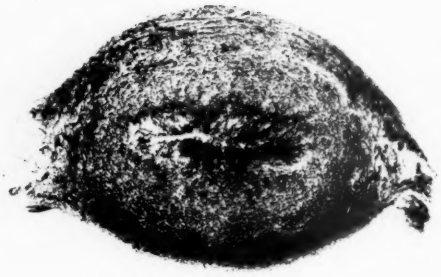

Fig. 12. Venous hyperæmia of the uterus and decidua formation. Very early tubal pregnancy. Radiograph (X 1) of a cross slice, 4 mm. thick, of the uterus; veins injected with bismuth. Operation five days after the beginning termination of the pregnancy. Tubal rupture, chorionic villi in the tube (see Case 2). While involution had begun, the influence exerted on the uterus by the pregnancy still predominates (see Figs. 13 and 14).

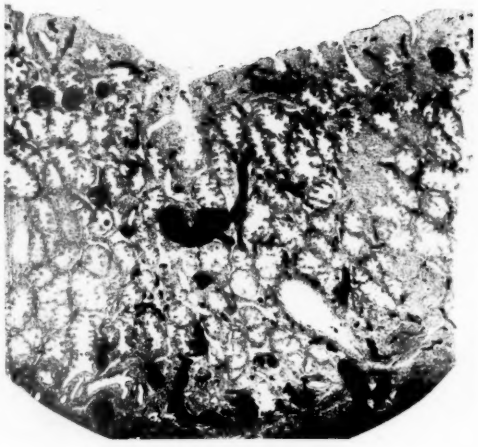

Fig. 13. Uterine decidua of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium from the uterus shown in Fig. 12. It resembles very closely the decidua vera of the early uterine pregnancy shown in Figs. 6 and 7. There is a distinct compact spongy layer; an arterial trabecula is present near right-hand border of the section. As in early uterine pregnancy, the development of the decidua is apparently dependent upon the arterial invasion of the endometrium from the terminal branches of the radial arteries. It differs from the decidua shown in Fig. 6 in that the arterial supply is not as well developed. The compact layer is not as thick as in the decidua shown in Fig. 11; it is a much earlier tubal pregnancy. Involution had begun, as shown by the dilatation of the venous spaces and escape of blood into the uterine cavity. (See also Fig. 15.)

of involution. The condition present was that of the regressive stage of involution.

Case 5. Age 33, para, youngest three years, a miscarriage at the third month occurred four months before. Tubal pregnancy was probably very early, patient had not missed her menstrual period and the tube was only slightly enlarged, embryo not found. Operation twelve days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding. The termination of the tubal pregnancy was by tubal abortion and apparently complete. A hematocele was found, and in removing the uterus and tube an egg-shaped clot was forced out of the tube, thus apparently completing the abortion, as chorionic villi were not found in the tube.

The arteries were injected with bismuth and the veins with ultramarine blue; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was very little, if any, enlarged, 5 x 4.2 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the uterus was negative, except for a small amount of the venous injecton mass in the uterine cavity. Radiographs of cross slices of the uterus demonstrated that the lumina of the arteries were small. There was a quite marked degree of sclerosis of many of the radial arteries and their branches, probably due to recent uterine pregnancies. The endometrium was thin, 1 to 2.5 mm., surface rough, covered with epithelium. The distal portion of the stroma stained faintly as though the tissues were poorly preserved, venous plexus dilated, no evidence of decidua, glands small and appeared few in numbers. The influence of the ectopic pregnancy on the uterus had disappeared. The condition present was that of the latter part of the regressive stage of involution.

Case 6. Age 27, first pregnancy. Age of tubal pregnancy was not determined. She thought she was three months pregnant, and had been curetted for supposed incomplete uterine abortion five days before her present operation. Operation three weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation.

The termination of the tubal pregnancy was by rupture and apparently complete; the manipulation of the tube at the time of the operation may have completed the termination of the pregnancy. A hematocele was found about the right tube, which was extensively mutilated by the rupture. Chorionic villi were not found. A pyosalpinx was present on the opposite side. The arteries were injected with bismuth. The uterus was enlarged to 6 x 4.5 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of the cross slices of the uterus showed that the shadows cast by the radial arteries were of normal

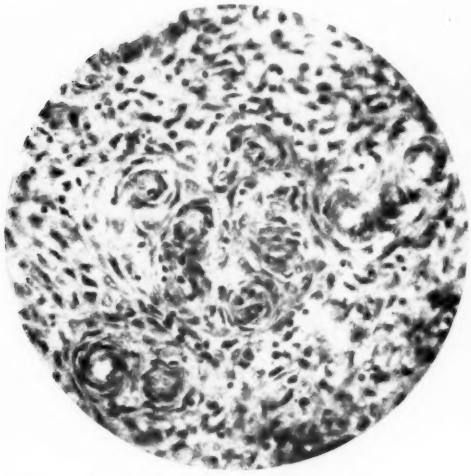

Fig. 14. Arterioles in the compact layer of the decidua of early tubal pregnancy. Photomicrograph (X 250) of a portion of the compact layer shown in Fig. 13. Tortuous arterioles with very small lumina are present in the compact layer and much more evident than in the non-pregnant condition, emphasizing that the development of the decidua and formation of compact layer are dependent upon the "arterial invasion" of the endometrium.

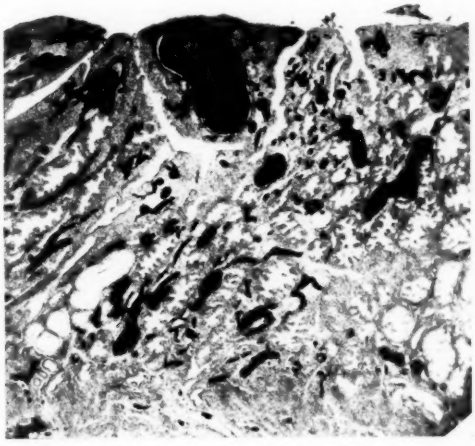

Fig. 15. Beginning involution of the uterine decidua of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium, Case 2, (from same uterus as Figs. 13 and 14). It shows well the dilatation of the venous spaces (black) apparently due to regressive changes in the stroma of the endometrium and possibly relaxation of the uterus. In this specimen the uterine bleeding arose from the superficial venous spaces, one shown about to rupture. Involution of the endometrium would probably occur in this case without the formation of a decidual cast, as the compact layer is thin (early pregnancy) and the rupture of the dilated superficial venous spaces would not separate the two layers.

size. There was very little, if any, evidence of sclerosis of the radial arteries, first pregnancy and only shortly after its termination. The endometrium was thin, 1 to 2 mm., rough, but for the most part covered with epithelium (curetted five days before); the glands were hypertrophied. No evidence of decidua.

It is impossible to draw any definite conclusion as to the relative influence of pregnancy and involution on account of the recent curettage.

Case 7. Age 30, para, last pregnancy nine years before. Tubal pregnancy was very early, skipped menstrual period for five days. See description of tube. Operation twenty-five days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, viz., pain and uterine bleeding, flowing at the time of the operation. The termination of the pregnancy was by rupture through the upper wall of the tube, incomplete. A hematocele was found about the right tube, the middle portion of which was dilated to a diameter of 2.5 cm. A small ragged opening about 3 mm. in diameter was found in the upper surface of this. A tubo-ovarian abscess was present on the opposite side. The embryo, 3 mm. in cross section, was found in a getsation sac (1 cm. in diameter) in the stained section of the tube.

The veins were injected with bismuth, and a large amount of this injection mass escaped into the uterine cavity. The uterus was enlarged to 5.7 x 5.4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of both the myometrium and endometrium were well injected and dilated. There was a moderate degree of sclerosis of the radial arteries.

The endometrium (Fig. 19) was thin, 1 to 2 mm., rough, but covered with epithelium, except where the injection mass had escaped. The compact layer, for the most part, was absent though persisting in places as polypoid projections. The stroma of these projections suggested atypical decidua and contained arterioles and venous spaces. The glands of the spongy layer were narrow, elongated; a few showed hyperplasia. The venous spaces were dilated. The bleeding arose from the rupture of the superficial venous spaces.

The influence of the ectopic pregnancy on the uterus was shown in the persistence of portions of the compact layer and hyperplastic glands. The regressive stage of involution presented itself in the partial destruction of the compact layer, dilated venous spaces, partial atrophy of the glands, and uterine bleeding.

Case 8. Age 39, para, last (only pregnancy) ten years before, followed by puerperal infection.

Fig. 16. Venous hyperæmia of the uterus, especially of the plexus of the endometrium; subinvolution of early tubal pregnancy. Radiograph (X 1) of a cross slice (3 mm. thick) of the fundus of the uterus; veins injected with bismuth. Operation ten days after the beginning termination of the pregnancy. Incomplete tubal abortion, gestation sac and chorionic villi in the tube, embryo had disappeared (Case 3.) The uterus is influenced both by the forces of involution and pregnancy, and, therefore, a condition of subinvolution exists (see Fig. 17).

Fig. 17. Early part of regressive stage of involution of the uterus, with dilatation of the venous spaces and uterine bleeding. Photomicrograph (X 20) of a portion of the endometrium (Case 3 and Fig. 16.) The early part of the regressive stage of involution is shown by the dilatation of the venous spaces (black), especially the superficial ones and the escape of the injection mass into the uterine cavity. The majority of the glands are no longer hyperplastic. The patient has been bleeding for ten days, and involution is still in the regressive stage and is retarded by the products of conception in the tube.

Tubal pregnancy was probably very early; patient had missed her period for only two weeks. See also description of tube. Operation twenty-three days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding. The termination was by tubal abortion, incomplete. The right tube was filled with a clot 3 mm. in its greatest diameter and partially protruding through the fimbriated end. A gestation sac, 1.8 cm. in diameter, without the embryo, was found in the tube.

The arteries were injected with bismuth and the veins with ultramarine blue; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged to 5.8 x 4.3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the uterus was negative except for a small amount of the venous injection mass in the uterine cavity and areas in the uterine wall, which proved to be adenomyomata. Radiographs of cross slices demonstrated that the arteries contained very little of the injection mass (later shown to be due to the arterial sclerosis). There was a marked degree of sclerosis of many of the radial arteries and their branches. Many small adenomyomata were present. The endometrium was thin, 1 to 2 mm. Surface thrown into folds, covered with epithelium. Compact layer for the most part was absent, no decidua. Glands small and few in numbers, stroma dense, venous spaces dilated, only a very few arteries were seen. The effects of pregnancy had almost disappeared. The condition of the endometrium was that of the latter part of the regressive stage of involution.

Case 9. Age 31, para, last uterine pregnancy four years before. Tubal pregnancy early, probably less than four weeks when symptoms of its termination began. See description of the pregnant tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, uterine bleeding, but pain had been present for only ten days; therefore probably only ten days had elapsed since the active beginning termination of the pregnancy; uterine bleeding the day of the operation.

The termination was by tubal abortion, though beginning signs of rupture were present, incomplete. A hematocele was found about the right tube which was distended (greatest diameter 3 cm.) with blood. In the center of this was the ovum, 2 cm. in its greatest diameter, and what was apparently the remains of the embryo, 3 mm. long. The arteries were injected with ultramarine blue and the veins with bismuth. The venous injection mass escaped freely into the uterine cavity. The uterus was slightly enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that both the plexus of the myometrium and endometrium were well injected

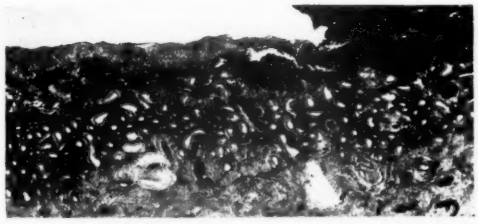

Fig. 18. Regressive stage of involution of the endometrium with extravasation of the injection mass between the compact and spongy layers and the formation of a decidual cast. Photomicrograph (X 20) of a portion of the endometrium; veins injected with bismuth (Case 9). Operation four weeks after the first sign of uterine bleeding but only ten days after the first attack of pain. Incomplete tubal abortion, gestation sac with remnant of embryo still in the tube. Endometrium thin, glands small, extravasation of the injection mass into the tissues of the endometrium, separating the compact from the spongy layer and causing a decidual cast. A condition of subinvolution exists, still in regressive stage. The incomplete termination of the pregnancy apparently prevented the complete involution of the uterus.

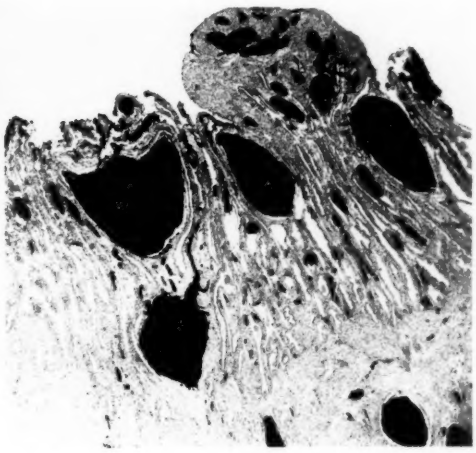

Fig. 19. Regressive stage of involution of the endometrium, dilated venous spaces and partial loss of the compact layer. Photomicrograph (X 20) of a portion of the endometrium; veins injected with bismuth (see Case 7). Operation twenty-five days after the beginning termination of the pregnancy. Termination by rupture (incomplete), gestation sac and embryo still in the tube. In places the compact layer is still present (appears as a polyp in the illustration), but for the most part it has disappeared. The venous spaces are dilated and some of the glands are still hyperplastic. The influence of pregnancy manifests itself by the persistence of areas of the compact layer and hyperplastic glands, and that of involution by the loss of the greater part of the compact layer, dilated venous spaces and atrophied glands. The influence of pregnancy has delayed the involution of the endometrium.

but not distended, probably due to the free escape of the injection mass into the uterine cavity. There was a moderate degree of sclerosis of some of the radial arteries.

The endometrium (Fig. 18) varied from 1 to 2 mm. in thickness, for the most part covered with epithelium. The compact layer resembled atypical decidua and in places was separated from the spongy layer by an extravasation of the venous injection mass, thus forming a decidual cast. The glands in the spongy layer were small and few in numbers; stroma dense. A few small arteries were seen in the base of the spongy layer.

The remains of the influence of pregnancy were still present in the compact layer of atypical decidua, which was partially separated from the spongy layer by the extravasation of the blood (injection mass). The regressive stage of involution was evident with the formation of a decidual cast, due to the above described extravasation of blood.

CASE 10. Age 37, para, youngest child fifteen years old (one miscarriage 8 years ago). Tubal pregnancy probably early when symptoms of its termination began. See description of the pregnant tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, attacks of pain and uterine bleeding, flowing slightly the day of the operation.

The termination was by tubal abortion, though beginning signs of rupture were present; termination incomplete. A hematocele was found about the right tube, which was distended with blood (greatest diameter 4.5 cm.). A gestation sac, 3.8 cm. in its largest diameter, was found in the tube, in which was a well-formed embryo 1.2 cm. in length. The arteries were injected with ultramarine blue and the veins with bismuth; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 7 x 5 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that both the plexus of the myometrium and endometrium were well injected. There was a moderate degree of sclerosis of some of the radial arteries. The endometrium varied in thickness from 1.5 to 2.5 mm. The surface was relatively smooth, covered with epithelium. The compact layer was thin and did not resemble decidua, stroma dense, venous spaces dilated. The glands of the spongy layer were small, stroma dense. The arteries were apparently few in numbers. The dilated venous spaces, with uterine bleeding, and small glands indicated involution retarded by the pregnancy.

CASE 11. Age 34, para, last uterine pregnancy a year before. Tubal pregnancy possibly of six to eight weeks' duration before its beginning termination, as the patient had skipped two menstrual periods, but began to flow a few days after the last period was due. Operation four weeks after the

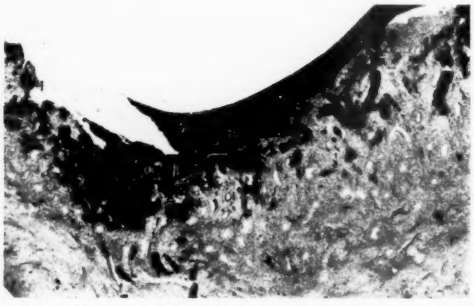

Fig. 21. Regressive stage of involution of the endometrium; extravasation of the injection mass into its tissues. Retardment of involution. Photomicrograph (X 20) of a portion of the endometrium; veins injected with bismuth (see Case 18). Operation six weeks after the beginning termination of the pregnancy. The termination was by rupture, apparently complete, but completed (last severe attack of pain two days before the operation) just before the operation. The endometrium is thin, glands atrophied, and there is no evidence of the influence of pregnancy other than the retardment of the involution. The latter is still in the regressive stage, as shown by the extravasation of the injection mass into the tissues.

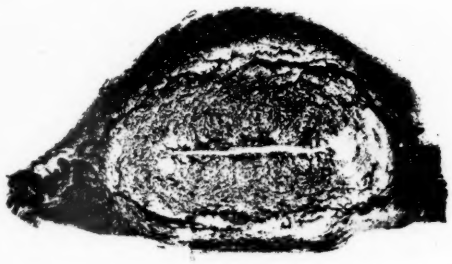

Fig. 22. Dilatation of the venous plexuses of the uterus, subinvolution of early tubal pregnancy. Radiograph (X 1) of a cross slice (4 mm. thick) of the uterus, veins injected with bismuth. Operation five weeks after the beginning termination of the pregnancy. Incomplete tubal abortion. Chorionic villi still in the tube, embryo had disappeared (Case 17). The endometrium is atrophied, but the venous spaces of both the endometrium and myometrium are dilated, suggesting a relaxation of the uterus. Involution is still in the regressive stage and its completion is apparently prevented by the influence exerted by the remains of the pregnancy in the tube (see also Fig. 23).

onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing freely the day of the operation.

The termination was by tubal abortion and incomplete. The distal portion of the left tube was distended with a pear-shaped blood clot, 7 x 4.5 cm., partially protruding through the fimbriated opening. Chorionic villi were found in this clot but not the embryo. The arteries were injected with Venetian red and the veins with ultramarine blue; there was a free escape of the venous injection mass into the uterine cavity. The uterus was slightly enlarged to 5.8 x 4.4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. In the gross specimen the veins of the myometrium and endometrium appeared dilated, and the uterine cavity was filled with the venous injection mass, which escaped from the endometrium (Fig. 20).[1] Many of the radial arteries showed a marked sclerosis; a few arterial shadows were seen near the endometrium; last uterine pregnancy a year ago.

The endometrium varied in thickness from 1 to 2.5 mm.; its surface was covered with epithelium. A definite compact layer was lacking, no evidence of decidua. The glands were small and few in number, the stroma was dense, the venous spaces were markedly dilated, a few arteries were seen in the base of the endometrium. The dilated venous spaces, thin endometrium, absence of decidua, small glands, few arterioles, and uterine bleeding indicated the regressive stage of involution prolonged by the pregnancy.

Case 12. Age (?), para, last uterine pregnancy three years before followed by puerperal infection; a puerperal pelvic abscess was incised and drained extraperitoneally through the groin. Tubal pregnancy was early. See description of the tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing the day of the operation. The termination of the pregnancy was by tubal abortion and incomplete. The distal portion of the right tube was distended with a blood clot, 5 x 2.8 cm., partially protruding from the fimbriated extremity. In the center of the blood clot was the gestation sac, 1.4 cm. in its longest diameter. The embryo was not found. Small bilateral ovarian cysts were present.

The arteries were injected with Venetian red and the veins with ultramarine blue; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was but slightly enlarged, 5.5 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus was negative except for a slight amount of the venous injection mass in the uterine cavity. Many of the radial arteries showed a marked degree of sclerosis (uterine pregnancy three years before). The endometrium

[1] Fig. 20. (See frontispiece.) Regressive stage of involution of the uterus and uterine bleeding. Colored photograph (X 1) of a sagittal section of the uterus, arteries injected red and veins blue (see Case 11). Operation four weeks after the beginning termination of the pregnancy; tubal abortion, chorionic villi still in the tube. The influence of pregnancy was not evident in the uterus except as involution was retarded and the regressive stage persisted with uterine bleeding.

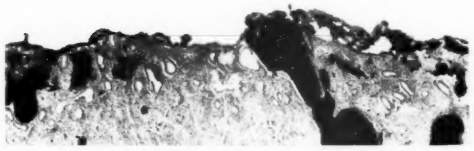

Fig. 23. Subinvolution of the endometrium, latter part of regressive stage. Photomicrograph (X 20) of a portion of the endometrium from the specimen shown in Fig. 22. The endometrium is atrophied, glands small, venous spaces dilated and an extravasation of the injection mass has occurred into the superficial tissues of the endometrium. There is no apparent evidence of the influence of pregnancy on the uterus other than the retardment of involution.

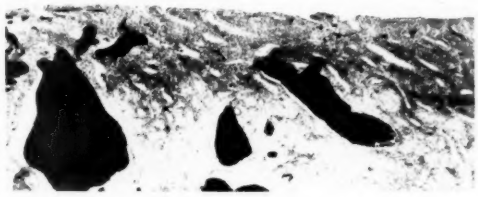

Fig. 24. Subinvolution of the endometrium, close of regressive stage or beginning reparative stage. Incomplete abortion of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium and myometrium; veins injected with bismuth. Operation four weeks after the beginning termination of the pregnancy. The termination was by abortion and incomplete, as gestation sac and chorionic villi were still present in the tube; the embryo had disappeared (Case 14). The endometrium is thin, surface relatively smooth, glands atrophied. Venous spaces dilated, but there was very little extravasation of the mass into the tissues of the endometrium (none in this section). Pregnancy has apparently retarded the progress of involution, and the latter is still in the regressive stage. Similar to Fig. 5 showing the postmenstrual stage.

varied in thickness, 2.5 to 3 mm.; its surface was smooth, covered with epithelium. The compact layer was œdematous, venous spaces dilated, did not resemble decidua. The glands of the spongy layer were small, stroma dense, and arterioles difficult to detect. The condition indicated the regressive stage of involution.

Case 13. Age 37, para, last uterine pregnancy nine years before. Tubal pregnancy probably very early, skipped period fourteen days. See description of the tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, but very little pain since the onset, suggesting that the termination was nearly completed with the first attack of pain.

The termination of the tubal pregnancy was by rupture through the upper wall of the left tube about 2.5 cm. from the fimbriated extremity. The tube was only slightly enlarged (1.8 cm. in its greatest diameter), and its lumen was filled with clotted blood. The termination of the pregnancy was not quite complete, as a few chorionic villi were found in the tube.

The arteries were injected with red lead and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged 6 x 4.5 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus was negative except for a small amount of the venous injection mass in the uterine cavity and the endometrium appeared hypertrophied. Some of the radial arteries showed a moderate degree of sclerosis. The endometrium varied from 4 to 6 mm. in diameter; the surface was smooth and covered with epithelium. The compact layer was œdematous and venous spaces dilated, and in places clotted blood in the stroma. The glands were moderately dilated, arteries in places easily detected. The thickened endometrium, with a definite compact layer, moderate glandular hyperplasia, and increased arterial supply, suggested the premenstrual stage of the endometrium, *i. e.*, a nearly complete involution of the latter (Fig. 28).[1] Involution had been progressing for four weeks with very little interference from the remains of the tubal pregnancy, as only a few chorionic villi were present in the tube and the history suggested the nearly complete termination of the pregnancy with the first attack of pain four weeks before.

Case 14. Age 29, para 1, and three miscarriages. Tubal pregnancy was probably early, had not missed her menstrual period. See also description of the tube. Operation four weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, viz., pain and uterine bleeding, flowing slightly the day of the operation. The termination of the pregnancy was by tubal abortion and incomplete. A hematocele was found about the left tube, which was distended to a diameter of 4 cm., a gestation sac ? cm. in diameter was present in the tube, but the embryo was not found.

The arteries were injected with ultramarine blue and the veins with bismuth; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged to 5.7 x 4.5 cm. in its greatest transverse and anterior

[1] Fig. 28. (See frontispiece.) Nearly complete involution of the uterus. Colored photograph (X 1) of a sagittal section of the uterus; arteries red and veins blue. Operation four weeks after a sudden severe attack of pain and collapse, suggesting the nearly complete termination of the tubal pregnancy with the first attack of pain (see Case 13). The nearly complete involution of the uterus has taken place, and though there were still a few chorionic villi in the tube their influence had gradually subsided and recently had very little influence on involution.

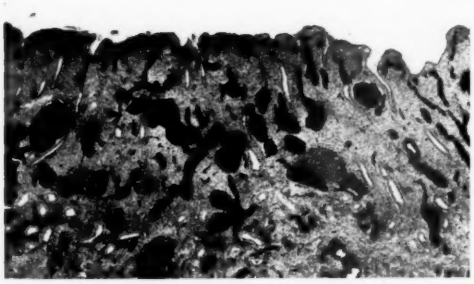

Fig. 25. Subinvolution of the endometrium, beginning reparative stage. Incomplete tubal abortion of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium and myometrium; veins injected with bismuth. Operation five weeks after the beginning termination of the pregnancy. A few chorionic villi were still in the tube; embryo had disappeared. (Case 16.) The endometrium is thicker than in Fig. 24, surface thrown into folds; glands still atrophied, and venous spaces dilated, but not the superficial ones. Involution has been and is still retarded by the influence of pregnancy, but the process of repair begins to manifest itself.

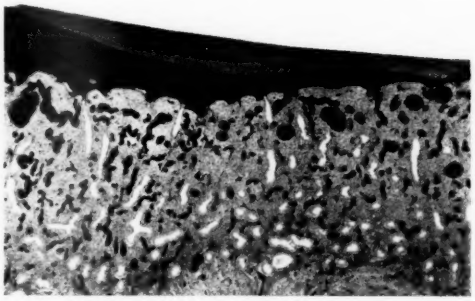

Fig. 26. Subinvolution of the endometrium, beginning reparative stage. Rupture (complete termination) of early tubal pregnancy. Photomicrograph (X 20) of a portion of the endometrium, veins injected with bismuth. Operation thirty-four days after the beginning termination of the pregnancy (Case 15). The endometrium is thicker than the one shown in Fig. 24. Surface thrown into folds. Glands larger (more active), but superficial venous spaces still dilated and the injection mass escaped into the uterine cavity. The process of repair has apparently begun, but the influence of the pregnancy, recently terminated, has retarded the involution of the uterus.

posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed a marked dilatation of the venous plexus of the inner two-thirds of the uterine wall and the endometrium.

Some of the radial arteries showed a moderate degree of sclerosis. The endometrium varied in thickness from 1.5 to 2.5 mm., for the most part smooth and covered with epithelium. A compact layer was absent over the greater portion of the endometrium, no evidence of decidua. A few arterioles were seen, glands small, stroma dense. Venous spaces were dilated; from these the uterine bleeding arose. The thin endometrium, absence of decidua, dilated venous spaces, uterine bleeding, small glands, and poor arterial supply indicated the regressive stage of involution, apparently maintained by the remnants of the pregnancy in the tube.

CASE 15. Age 34, para, youngest child twenty months old. The age of the tubal pregnancy was not determined, but probably early. Operation thirty-four days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing at the time of the operation. The termination of the pregnancy was by rupture. A hematocele was found about the left tube which had ruptured, severe pain only a few days before the operation; the embryo was not found and no chorionic villi were found in the tube.

The arteries were injected with Venetian red and the veins with bismuth; the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.8 x 4 cm. in its greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the cut surfaces of the uterus was negative except for a small amount of the venous injection mass in the uterine cavity. Radiographs of cross slices of the uterus showed that the venous plexus of the myometrium was not dilated. There was a marked degree of sclerosis of many of the radial arteries, probably due to uterine pregnancy twenty months before.

The endometrium (Fig. 26) varied from 1.5 to 3 mm. in thickness, and was covered with epithelium. The compact layer was œdematous in places and the venous spaces dilated. The glands were moderately dilated, suggesting activity. The condition found suggested a beginning repair of the endometrium as in Case 13. Bleeding arose from the dilated venous spaces. The thickened endometrium with formation of compact layer, dilated glands, and increased arterial supply indicated the reparative stage of involution. The dilated venous spaces and uterine bleeding showed that the regressive stage had not ceased.

CASE 16. Age (?), para, age of children (?). Tubal pregnancy was probably early, although the tube contained a very large blood clot. Operation five weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation. The termination of the pregnancy was by tubal abortion and not complete, as chorionic villi were found in the tube. A hematocele was found about the right tube, which was distended with a blood clot 7 cm. in its greatest diameter. An ovarian cyst, 5 cm. in diameter, was present on the opposite side.

Fig. 27. Complete involution of the endometrium, end of reparative stage. Photomicrograph (X 20) of a portion of the endometrium (poorly injected). Operation forty-five days after the beginning termination of the pregnancy and two weeks after any severe pain (see Case 20). The endometrium is hypertrophied, surface rough; there is hyperplasia of the glands; the picture resembles the premenstrual stage of the non-pregnant uterus (Fig. 4).

Fig. 29. Evidence of arterial sclerosis, uterus of early tubal pregnancy (sclerosis probably due to recent uterine pregnancy). Radiograph (X 1) of a cross slice (3 mm. thick) of the uterus; arteries injected with bismuth. Operation twelve days after the beginning termination of the pregnancy; incomplete tubal abortion (see Case 4). The arteries appear to be poorly injected, due to arteriosclerosis, causing narrowing of the lumina. Compare with Fig. 1. Youngest child eleven months old, probable cause of arteriosclerosis; patient's age 28. All cases must be studied with a knowledge of the age of the patient, and if parous the date of the last pregnancy.

The arteries were injected with ultramarine blue and the veins with bismuth; a small amount of the venous injection mass escaped into the uterine cavity. The uterus was only slightly enlarged, to 4.8 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed the venous plexus of the myometrium was only fairly well injected and moderately dilated. There was a moderate degree of sclerosis of many of the radial arteries. The endometrium (Fig. 25) varied in thickness from 2 to 3 mm. Surface corrugated and covered by epithelium. Compact layer thin, no decidua, glands few in number and not hypertrophied, stroma moderately dense, arteries few in number. Venous spaces dilated. Condition suggests a beginning repair of the endometrium.

CASE 17. Age 35, first pregnancy (married ten years). The tubal pregnancy was very early, had not missed her period. (See also description of the pregnant tube.) Operation five weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, viz., pain and uterine bleeding, slight uterine bleeding at the time of the operation. The termination of the pregnancy was by tubal abortion and incomplete, as chorionic villi were found in the tube. A hematocele was present about the right tube, the ampulla of which was distended with a blood clot 4 cm. in its greatest diameter. Gestation sac and embryo were not found. Both tubes showed tuberculosis.

The arteries were injected with ultramarine blue and the veins with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, 5.1 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs (Fig. 22) of cross slices of the uterus showed the venous plexus of both the myo- and endometrium were well injected and dilated. There was a moderate degree of sclerosis of many of the radial arteries.

The endometrium (Fig. 23) was in many places less than 1 mm. in thickness and covered with epithelium. A compact layer was absent, no decidua. The glands were small, few in number, stroma dense, and no evidence of tuberculosis. Arteries were not seen; some of the venous spaces were greatly dilated and subepithelial extravasations of the injection mass were present with rupture and escape of the mass into the uterine cavity. The thin endometrium, absence of decidua, small glands, poor arterial supply, dilated venous spaces, and uterine bleeding indicated the latter part of the regressive stage of involution.

CASE 18. Age 32, para, youngest twelve years old, one miscarriage two years before present operation. Tubal pregnancy probably early, had not missed the menstrual period. See also description of the tube. Operation six weeks after the onset of symptoms, suggesting the beginning

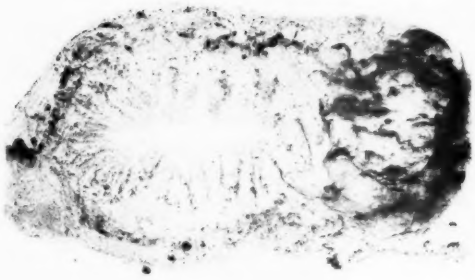

Fig. 30. Evidence of arteriosclerosis, uterus of interstitial tubal pregnancy but parous woman, youngest child nine years old. Radiograph (slightly reduced) of a cross slice (4 mm. thick) of the fundus of the uterus through the interstitial pregnancy. Arteries injected with red lead. Operation thirty-two days after the beginning termination of the pregnancy (see Case 25). The radial arteries appear to be poorly injected, due to narrowing of the lumina. There is an extravasation of the arterial injection mass between the gestation sac and surrounding uterine tissue. Patient 37 years old; last uterine pregnancy nine years ago. The degree of arteriosclerosis suggests that it may in part be due to involution of the uterus following the beginning termination of the tubal pregnancy 32 days before.

termination of the pregnancy, viz., pain and uterine bleeding, flowing freely at the time of the operation. The termination of the pregnancy was by rupture and was apparently complete, *i. e.*, chorionic villi were not found in the tube; still the manipulation of the tube at the time of the operation may have completed the termination of the pregnancy. A large hematocele was found about the right tube, the ampulla of which had ruptured.

The arteries were injected with Venetian red and the veins with bismuth. A large amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.2 x 4.1 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the myometrium was poorly injected and not dilated, probably due to the free escape of the mass into the uterine cavity. Microscopically many of the radial arteries and their branches showed a moderate sclerosis. The endometrium (Fig. 21) was thin, from 1 to 2 mm., rough, covered with epithelium, except where the injection mass escaped into the uterine cavity. There was no definite compact layer or decidua. The glands were small and few in number and the stroma dense. A few small arteries were seen in the stroma (11 sections examined). Only a few of the venous spaces of the endometrium were dilated. The venous injection mass had escaped into the tissues of the endometrium and from there into the uterine cavity. The thin endometrium, absence of decidua, small glands, poor arterial supply, escape of blood into the stroma of the endometrium, and uterine bleeding indicated the regressive stage of involution maintained for six weeks by the incomplete termination of the tubal pregnancy; last attack of severe pain two days before the operation.

Case 10. Age 42, married nineteen years, first pregnancy, history of a former pelvic peritonitis. Tubal pregnancy probably very early, had missed period for only a "few days." See also description of the pregnant tube. Operation six weeks after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly the day of the operation. The termination was by tubal abortion and incomplete, as chorionic villi were found in the tube. A hematocele was found about the left tube, which was distended with a blood clot 3 cm. in its greatest diameter. A gestation sac 1.5 cm. in diameter was found in the tube; embryo not found, but shadows of villi were present. Opposite tube and ovary bound down by old adhesions.

The arteries were injected with Venetian red and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.5 x 3.8 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected uterus was negative, except for a slight amount of the venous injection mass in the uterine cavity, which arose from the endometrium. Some of the radial arteries showed a slight degree of sclerosis.

The endometrium varied in thickness from 2 to 3 mm.; its surface was relatively smooth, covered with epithelium. The compact layer was œdematous but no decidua. The glands of the spongy layer were for the most part small, a few were dilated, and stroma dense. The venous spaces in places were dilated. A few small arteries were seen in the base of the endometrium. The condition indicated subinvolution, the latter part of the regressive stage or beginning reparative stage.

Case 20. Age 30, para, last uterine pregnancy a year before. Tubal pregnancy probably was very early. See description of the pregnant tube. Operation forty-five days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding. The termination of the pregnancy was by rupture through the upper wall of the right tube about 2 cm. from the fimbriated extremity. The tube was only slightly enlarged (1.5 cm. in its greatest diameter), and its lumen was filled with clotted blood. The termination of the pregnancy was incomplete, as chorionic villi were found in the tube.

The arteries were injected with Venetian red and the veins with ultramarine blue. A slight amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6 x 4.3 cm. in the greatest transverse and anterior posterior

diameters of the hardened specimen. The gross appearance of the injected uterus was negative except for a very small amount of the venous injection mass in the uterine cavity. Some of the radial arteries showed a moderate degree of sclerosis. The endometrium (Fig. 27) varies from 3 to 4 mm. in thickness; its surface was wavy and covered with epithelium, compact layer was œdematous, no decidua. The glands were hypertrophied, some of the venous spaces dilated; a few small arteries were found in the base of the endometrium. The condition resembled the premenstrual stage of the endometrium, *i. e.*, involution was complete.

CASE 21. Age 36, para, youngest sixteen years old, three years before the left tube and ovary had been removed for tubal pregnancy. Age of present tubal pregnancy probably six to eight weeks; the embryo, 4 cm. long, was found in the peritoneal cavity. Operation fifty-four days after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, *i. e.*, pain and uterine bleeding, flowing slightly at the time of the operation. Severe pain eleven days before. The termination of the tubal pregnancy was by tubal abortion and incomplete, as chorionic villi were found in the blood clot in the tube. A hematocele was found about the right tube, which was enlarged to 3.5 cm. in its greatest diameter; the fœtus, 4 cm. in length, was found in the blood clot outside the tube.

The arteries were injected with bismuth and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6.2 x 5.3 in the greatest transverse and anterior posterior diameters of the hardened specimen. The radial arteries showed a moderate degree of sclerosis. The endometrium varied in thickness from 2 to 3 mm., irregular in outline, covered by epithelium. Compact layer absent, no decidua. Some of the glands were hypertrophied, arteries few in numbers, venous spaces dilated. The condition present was that of subinvolution, regressive stage.

CASE 22. Age 29, para (1), ten years before. Tubal pregnancy was early, had not missed her menstrual period. See also description of tube. Operation eight weeks after the onset of symptoms, suggesting the beginning termination of the tubal pregnancy, viz., pain and uterine bleeding, slight flow at the time of the operation.

The termination of the pregnancy was by tubal abortion and incomplete. A hematocele was found about the right tube, the ampulla of which was distended by a blood clot 2 cm. in its greatest diameter. A few villi were found in the blood clot; the embryo was not found. The opposite tube was occluded.

The arteries were injected with ultramarine blue and the veins with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was slightly enlarged, to 5.3 x 4.1 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs

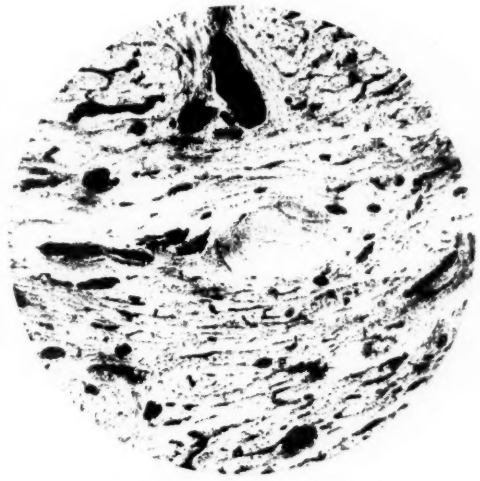

Fig. 31. Arteriosclerosis, uterus of tubal pregnancy. First pregnancy. Photomicrograph (X 20) of a portion of the uterine wall. Veins injected with bismuth. Operation seventy-two days after the beginning termination of the tubal pregnancy; incomplete tubal abortion (see Case 24). A greatly thickened artery can be seen in the center of the figure, difficult to detect from the surrounding myometrium. Venous spaces filled with the injection mass (black). Patient 36 years old; first pregnancy. Involution had been going on for seventy-two days though delayed by the incomplete termination of the pregnancy. It is possible that the involution of ectopic pregnancy is associated with arteriosclerosis of the radial arteries as is uterine pregnancy.

of cross slices of the uterus showed the venous plexus of both the myometrium and endometrium to be well injected and dilated. There was a moderate degree of thickening of some of the radial arteries. The endometrium was thickened from 2.5 to 4 mm. and covered with epithelium. The compact layer was present, dense, no decidua. The majority of the glands of the spongy layer were of small size; a few were hypertrophied. A few arteries seen at the base, venous spaces in places dilated. The condition was that of involution, reparative stage.

CASE 23. Age 36, one miscarriage four years before (induced), pelvic peritonitis three years before. Tubal pregnancy was probably very early. See also description of the tube. Operation eight weeks after the onset of symptoms, *i. e.*, pain and uterine bleeding, suggesting the termination of the pregnancy. The patient had had several hæmorrhages from the rectum, the first one five weeks before the operation, and at operation the pregnant tube was found to communicate with the sigmoid. The termination of the pregnancy was by abortion through the fimbriated extremity of the left tube into the sigmoid. The tube was filled with

a blood clot about 6 x 4.5 cm., and the opening in the wall of the sigmoid could easily admit the tip of one's little finger. Chorionic villi were found in the tube. A small cyst 4 cm. in diameter was present in the opposite ovary.

The arteries were injected with Venetian red and the veins with ultramarine blue. There was a slight escape of the venous injection mass into the uterine cavity. The uterus was only slightly enlarged, to 4 x 3 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. The gross appearance of the injected specimen was normal except for a slight amount of the venous injection mass in the uterine cavity. There was a slight sclerosis of some of the radial arteries. The endometrium was thin, from 1 to 2 mm., and covered with epithelium. A thin compact layer was present but no decidua. Many of the glands were hypertrophied and a few arteries were present. Although the endometrium was thin the presence of a compact layer, arteries, and hypertrophied glands indicated the reparative stage of involution.

CASE 24. Age 26, first pregnancy. Tubal pregnancy probably very early. See description of the pregnant tube. Operation seventy-two days after the onset of symptoms, suggesting the beginning termination of the pregnancy, *i. e.*, pain and uterine bleeding; uterine bleeding was intermittent, but present the greater part of the time from the first attack of pain. The termination of the tubal pregnancy was by tubal abortion and incomplete. A hematocele was present about the right tube, which was enlarged to 4 cm. in its greatest diameter; gestation sac, 3 cm. in diameter, with remains of embryo, 5 mm. long, still within the tube even after seventy-two days.

The veins were injected with bismuth. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged to 6 x 4 cm. in the greatest transverse and anterior posterior diameters of the hardened specimen. Radiographs of cross slices of the uterus showed that the venous plexus of the uterine wall was well injected, spaces not dilated. There was an extensive thickening of the arteries of the uterine wall often difficult to distinguish from the surrounding myometrium, and this was especially true of the terminal branches of the radial arteries just beneath the endometrium. The endometrium was thin, in places devoid of epithelium, no compact layer or decidua. Glands few in number and small, stroma compact, venous spaces injected.

The regressive stage of involution was still present even after seventy-two days, apparently due to the incomplete termination of the tubal pregnancy.

CASE 25. Age 37, para, youngest nine years old. Age of ectopic pregnancy probably early (see description below), missed one menstrual period and began to flow at the time of the next regular period, when a decidual cast was passed and thought to be an early uterine abortion. Operation thirty-two days after the onset of symptoms, suggesting the beginning termination of the ectopic pregnancy, *i. e.*, uterine bleeding with very little pain, flowing at the time of the operation. The pregnancy was situated in the interstitial portion of the right tube and the cornua of the uterus was about to rupture, the gestation sac (3.5 cm. in diameter) being entirely separated from the surrounding uterine tissue by blood and the anterior wall of the uterus very thin over it. The embryo had apparently been entirely absorbed. Microscopically chorionic villi were present in the clot.

The arteries were injected with red lead and the veins with ultramarine blue. A small amount of the venous injection mass escaped into the uterine cavity. The uterus was enlarged and contained several small myomata. Many of the radial arteries showed a moderate degree of sclerosis (Fig. 30).

The endometrium was thin, 1 to 2 mm., covered with epithelium, glands were small, a few arteries in the base of the endometrium, venous spaces dilated in places, no decidua found. Subinvolution, regressive stage was still present.

SUMMARY OF THE INFLUENCE OF ECTOPIC PREGNANCY ON THE UTERUS AND THE CAUSE OF UTERINE BLEEDING IN THESE CASES

Under the influence of early ectopic pregnancy (all my observations were confined to early ectopic pregnancy, as the largest fœtus was only 6 cm. long) the uterus becomes larger than normal. The increase in size of the uterus is due to two evident factors; *i.e.*, hyperæmia and a thickening of the endometrium. Possibly the muscle fibers are also increased in size but of this I am not certain. The changes in the endometrium are quite similar to those found in the decidua vera of early uterine pregnancy and also vary with the age of the pregnancy. In the earliest ectopic pregnancy of my series the compact layer formed only about one-fifth of the thickness of the decidua, while in the most advanced case (fœtus 6 cm. long) over one-half of the decidua consisted of the compact layer. The endometrium lining the entire cavity of the body of the uterus takes part in this change (see Fig. 11). The compact layer of the endometrium contains many arterioles (Fig. 14), about which the decidual cells first develop, and in the very early ectopic pregnancies it is difficult to distinguish this layer from the compact layer found in the premenstrual stage of the non-pregnant

uterus, just as it is difficult to distinguish the latter from the decidua vera of a very early uterine pregnancy. Spaces filled with venous blood are also found in this layer. The spongy layer is composed of hypertrophied glands as in uterine pregnancy, and in places there is very little stroma between them. Trabeculæ are also present which cross the spongy layer and unite the compact layer with the myometrium. These trabeculæ or pillars are composed of stroma and contain branches of the radial arteries and also veins, which cross the spongy layer and terminate in the compact layer. These trabeculæ are more evident than in the non-pregnant condition, though possibly not quite as evident as in uterine pregnancy. The arterioles of the endometrium are larger and appear more numerous than in the premenstrual stage of the non-pregnant uterus; they follow a spiral course, and are easily distinguished from the veins which are merely spaces in the stroma of the endometrium. There is often a decidual reaction of the stroma about the arteries in these trabeculæ. The development of the compact layer itself and also of decidual cells seems to be intimately associated with the "arterial invasion" of the endometrium which takes place through these trabeculæ. The venous spaces are found everywhere in the stroma of the endometrium, but especially in the compact layer and at its junction with the spongy layer. It is difficult to detect any change in the uterine wall other than the arterial and venous hyperæmia.

It is reasonable to believe that forcible contractions of the uterus (labor) accompany the attempts of the pregnant tube to expell its contents. The uterus develops from a fusion of the Müllerian ducts, and the clinical symptoms suggest this. These contractions by compression would lessen the arterial supply of the endometrium and otherwise damage its structure. These damages apparently cause an extravasation of blood from the venous spaces, and the ones most readily affected are those in the compact layer near the uterine cavity and at the junction of the compact and spongy layer.

Following the complete termination of the tubal pregnancy uterine involution takes place, which differs in degree from that following the termination of the uterine pregnancy. The uterus becomes smaller, due to decreased arterial and venous hyperæmia and atrophy of the endometrium. The muscle cells may also decrease in size, and I also believe that a certain amount of sclerosis of the radial arteries and their branches occurs.

We may recognize two distinct phases in the involution of the uterus following the termination of ectopic pregnancy: *first, the destructive or regressive stage;* and, *secondly, the constructive or reparative stage.*

The earliest regressive changes in the endometrium that we are able to detect are a dilatation of the venous spaces and the escape of blood into tissues of the endometrium. The dilatation of the venous spaces and escape of venous blood are most evident in the superficial portion of the compact layer and at the junction of the compact and spongy layer. The regressive changes are apparently due to (1) forcible uterine contractions injuring the structures of the endometrium; (2) interference with the arterial supply of the endometrium—the latter may be due to contraction of the radial arteries or actual sclerosis; and, finally, (3) a condition of venous congestion as shown by the dilatation of the venous spaces throughout the uterus, *i.e.*, an index of uterine relaxation. The rupture of the superficial venous spaces of the compact layer gives rise to subepithelial extravasation of blood, which soon escapes into the uterine cavity, and if this type predominates involution of the endometrium would occur without the expulsion of a decidual cast. On the other hand, the rupture of the venous spaces at the junction of the compact and spongy layer separates the two layers and may give rise to a decidual cast. In some cases the entire compact layer is destroyed in small fragments or is expelled as a cast. The glands of the spongy layer become smaller and apparently fewer in number. Although the endometrium is thinner than normal during this stage of involution, the uterus as a whole is larger, due to the venous congestion, *i.e.*, uterine relaxation. (See measurements of uteri in report of cases.) The condition present at the end of the regressive or destructive stage is an atrophied

endometrium, compact layer absent or very thin, but the surface covered with epithelium, glands small and apparently few in numbers, stroma dense, *arterioles apparently few and difficult to detect*, venous spaces dilated.

In the constructive or reparative stage the endometrium becomes thicker, its surface is thrown into folds and there is a formation of a compact layer and glandular hyperplasia. The arterioles are apparently more evident, and I believe that it is initiated by the "arterial invasion" of the endometrium.

In the majority of the cases of ectopic pregnancy the complete termination of the pregnancy is a gradual process, associated with repeated attacks of pain (labor), and some of the products of gestation (chorionic villi, etc.) may remain in the tube in an active condition for several days or even weeks and months (were present in seventeen of the twenty-five cases over four weeks) after the beginning termination of the pregnancy. Therefore in these cases the process of involution is delayed by the influence of an incomplete termination of the pregnancy, a condition apparently analogous to subinvolution of the uterus, due to retention of some of the products of uterine conception. As these cases are operated upon after the onset of the termination of the pregnancy, the uterus has already been influenced by three factors or forces; the first of these is pregnancy; the second is labor; and thirdly, with the onset of the termination of the pregnancy, *i.e.*, labor, the involution of the uterus begins. The stimuli exerted on the uterus by pregnancy and involution are therefore antagonistic.

The changes found in the uterus in any given case would depend upon which of these factors or forces predominate and to what extent it is influenced by the other two.

The uterine bleeding in ectopic pregnancy arises from the endometrium, is of venous origin and is but a manifestation of the regressive stage of involution. The regressive stage of involution is prolonged in the majority of the cases because the termination of the pregnancy is rarely completed with the first attack of pain, and, as long as it is incomplete and actively influences the uterus, a condition of subinvolution exists and uterine bleeding usually persists.

EDUCATION AND PUBLICITY THROUGH THE COUNCIL ON HEALTH AND PUBLIC INSTRUCTION OF THE AMERICAN MEDICAL ASSOCIATION[1]

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IN order to cover the subject assigned to me in the limited time allowed, it will be necessary to condense the discussion and limit statements to obvious conclusions rather than to attempt a discussion of details.

The duty and responsibility of the organized profession in the education of the public on cancer and its prevention is practically the same as in any other preventable disease. The subject under discussion, therefore, really is: "What is the duty of the organized medical profession in the education of the public on the prevention of disease?" As soon as this question is asked, another question immediately presents itself, namely: "Why should the public be educated regarding preventable disease?" No such necessity has presented itself in past generations. Why is it the duty of the present generation of medical men to instruct the public on disease and its prevention? This question must be answered both from the standpoint of the public and of the profession.

Viewed from the standpoint of social welfare, the justification for public education is to be found in the fact that to-day, for the first time in the history of civilization, the prevention of disease is a social rather than a medical problem. In previous generations epidemics appeared, caused great loss of life, and finally burned themselves out and disappeared, without any possibility of physicians controlling or suppressing them. The only duty which physicians owed was to their individual patients. They owed no duty to society at large, because they possessed no knowledge by which disease could be prevented or controlled in the mass. To-day, our knowledge of the cause of disease, its method of transmission, and the possibility of its prevention imposes a duty on the profession toward the public, which is being recognized as a most important function of the medical profession. Since scientific medical men alone possess the technical knowledge necessary for the handling of such problems, society must look to them for such knowledge. But when an effort is made to apply this knowledge for the production of practical results, it is found that while the specific cause of a disease and the life history of the organism may be known in the most minute detail, the prevention or suppression of the disease is a social and not a scientific problem.

Take tuberculosis as an example. There is little more to be learned to-day regarding the tubercle bacillus. The method of transmission and the possibilities of prevention of tuberculosis are well understood. But the actual prevention of the disease involves the solution of such problems as factory and tenement-house construction and inspection, medical school inspection, sanitation of railways and street cars, regulation of women's labor, child welfare, sweat shops, and factories, as well as a knowledge of labor conditions, wages, housing conditions, nutrition, and personal habits. The scientific facts regarding tuberculosis are generally recognized and appreciated. The application of these facts and the recognition of the essential factors in the social problem are either as yet undetermined or, if recognized, have not as yet been brought under adequate control.

The enforcement of regulations which would make effective our present knowledge in the prevention of disease is possible only through the exercise of an autocratic and absolute authority, without any reference to the prejudices or feelings of the public, or through an educated public opinion which would sustain and enforce sanitary regulation for the public good. Autocratic control in a country like ours is impossible. Regulation can come only through the force of public

[1] Read before the Clinical Congress of Surgeons of North America, November 1, 1913.

opinion. But such public opinion, in order to be effective, must be intelligent and must be guided by the best scientific knowledge obtainable in order to arrive at correct conclusions and to act intelligently. Increasing knowledge of the cause of diseases, perfection of methods for their prevention, as well as the recognition of the paramount importance of regulation of social conditions for such prevention, make it necessary that there should be an educated public sentiment back of all of our efforts for disease control. The real force in this country, and the only effective force, is public opinion. Laws are the crystallization of public opinion and not one of its formative influences. When this principle is fully recognized, we will cease to advocate the adoption of mandatory laws without first creating a discriminating and intelligent public opinion on the necessity and importance of such regulation. If the education of the public is properly carried out, the number of laws required will be greatly diminished and the effectiveness of those in force will be proportionately increased.

From the standpoint of the physician, education of the public is necessary for effective work, as it is the duty of the medical profession to cure disease when it has actually occurred and to prevent disease wherever possible. As long as the causes of disease were unknown, the physician needed only the coöperation of his individual patients. To-day, my act may not harm me or my family, but may bring disease and death to my neighbor; while my neighbor's carelessness or lawlessness may be dangerous to me, no matter how law-abiding I may be. The understanding and support of an intelligent public is to-day necessary in order that the physician may effectively carry on his work and fulfill his duty to his individual patients.

Public education regarding disease and its prevention being a necessity both from the public and professional standpoint, how is this to be secured, and through what agencies is such education to be carried on? Obviously, it should be so conducted as to reach the public through the most authoritative source possible; through a medium that will be recognized as representing the entire profession, rather than any sections or portions thereof; through a single agency rather than through many, in order to avoid the confusion of the public mind which would result through a multitude of teachers. Practical conditions must also be considered. The expense and the labor required must be reduced to a minimum, and each subject must be so presented as to be intelligible to the average reader and capable of public assimilation. The many important subjects must be presented in accordance with their relative importance. The public is not in a position to distinguish between theories in the form of working hypotheses on the one hand, and demonstrated facts on the other hand; neither is it in a position to reserve judgment on a scientific question pending the production of further evidence. It is essential that only demonstrated facts which have been accepted by practically the entire medical and scientific world should be presented to the public attention. Fads, hobbies, half-baked theories, and fanciful hypotheses have no place in any scheme of public education. The recognized facts must be presented in language which is intelligible to the general public, and in a form which will be familiar. The facts must be presented in such a way as to show their practical importance rather than their abstract scientific value, and without an effort to moralize, each statement made must carry with it an implication of personal duty and responsibility on the part of the reader.

The necessity for public instruction on the prevention of disease has been recognized by practically all of our state boards of health and by many of our municipal health departments, as well as by the various federal bureaus working on public health and allied subjects. It has also been recognized by the organization of a large number of special voluntary societies, composed of those interested in some special problem and devoted to the arousing of public sentiment on this specific subject. Among such organizations may be mentioned the National Association for the Study and Prevention of Tuberculosis, The American Association for the Study

and Prevention of Infant Mortality, The American Association for the Study of the Feeble-Minded, The National Association for the Study of Epilepsy, and The American Society on Sanitary and Moral Prophylaxis. In this class belongs the new organization already referred to — The American Society for the Control of Cancer.

While the duty of the organized medical profession for the education of the public has long been recognized, and has led at different times to the appointment of special and temporary committees on various phases of the problem, it was not until three years ago that the considerations which I have discussed above led to the organization by the American Medical Association of a permanent board or council charged with the specific task of representing the medical profession of the United States before the public, with determining its relation with other public bodies, and with the education of the public on disease and its prevention.

In 1910, the American Medical Association provided for a Council on Health and Public Instruction, to be made up of five members. This Council now consists of Dr. H. B. Favill of Chicago, chairman; Dr. H. M. Bracken, secretary of the Minnesota State Board of Health; Dr. W. B. Cannon, Harvard University; Dr. W. C. Woodward, Health Officer of the District of Columbia, and Dr. W. S. Rankin, secretary of the North Carolina State Board of Health, these gentlemen representing the philanthropic, scientific, and practical public health work of the Association. Recognizing the enormous importance of this new work, the unlimited field which presented itself, and the need of laying a sound foundation for the future efforts to educate the public, the Council has, in the last three years, devoted most careful consideration to the entire problem of the education of the public in preventable diseases. While carrying on these deliberations it was necessary to inaugurate some immediate work for the establishment of better relations between the medical profession and the public.

Recognizing the importance of newspapers as public educators and as molders of public opinion, one of the first activities established by the Council was a press bureau. In July, 1910, the press bureau was established, by which a weekly bulletin was prepared and sent to five thousand newspapers. This bulletin consisted of a clipping sheet, containing short paragraphs on public health topics of current interest which were specially prepared for insertion in the public press. Letters from editors and clippings from press bulletins combine to show the growing value of this educational feature and the increasing confidence of newspaper editors in the value of this propaganda and the disinterestedness of our motives. To-day it is possible, through this medium, to place in the hands of five thousand newspaper editors material which they recognize as authoritative, representative, and animated by unselfish motives.

The necessity of a single channel of communication with the press of the country is obvious. There is to-day in the United States a constantly growing group of organizations interested in some phase of the public health problem. While the very number is uncertain, there are probably to-day nearly seventy-five such organizations. If each of these bodies attempted to maintain its own press service and to supply the newspapers of the country with material suitable for publication, not only would the expense and labor be duplicated seventy-five times, but the newspapers of the country would be bewildered and confused by the mass of material sent them; while the attempt to prepare separate bulletins on each specific subject would result in the elaboration of unimportant details and the production of an enormous amount of unnecessary material. The concentration of this material in a single bulletin, prepared specially for newspaper purposes, enables the newspaper editor to select those subjects which he regards as of importance or of special interest to his readers, and to choose a variety of topics that would not be possible if the bulletin were devoted to the discussion of a single phase of the public health question.

The most important reason, however, why such matter should be sent out by the American Medical Association is that the Association is the owner of the largest and

most complete medical printing plant in the United States, if not in the world. Owing to the development of *The Journal of the American Medical Association* and its unparalleled business management during the last fifteen years, under the editorship of Dr. George H. Simmons, the Association to-day owns a large office building, with printing plant, office equipment, and other facilities. The surplus earned by the *Journal* is distributed each year by the Board of trustees to the various boards and councils carrying on the Association work. The educational work of the Council on Health and Public Instruction is to-day made possible only by the earnings of the *Journal*, which are practically the surplus of the dues and subscriptions of physicians after the expense of the *Journal* and the Association are paid.

As the Council is the representative of the Association and the profession before the public, this bulletin is open to anybody or any organization working for the education of the public on health topics. We have the means by which the newspapers and the public can be reached. The amount of suitable material which can be so circulated is practically unlimited. Any material furnished by societies or organizations will be thoroughly welcome and effectively utilized.

The next activity undertaken by the Council was the organization of a speakers' bureau. Two hundred of the leaders of the profession in various parts of the country were asked to contribute their services to the extent of giving from six to eight addresses a year before meetings arranged by local organizations under the auspices of the speakers' bureau. One hundred and thirty-five accepted. Announcements of the bureau, giving the names of the speakers, the subjects, and conditions under which they could be secured, were sent to the secretaries of medical societies, women's clubs, universities, teachers' institutes, farmers' institutes, and other local organizations. In the case of appointments made through the bureau the speaker donates his time, the Council pays the traveling expenses of the speaker, and the local organization provides the meeting-place and advertises the meeting. In this way, by a division of expenses, the burden does not fall heavily on any one, and any city or town in which the local organization will unite for a meeting on public health can be given a speaker of high scientific ability to deliver an address on a suitable health topic.

Last year, speakers were furnished for over 350 meetings between November 1, 1912, and June 1, 1913. This year, over fifteen thousand announcements have been sent out, and the work of the speakers' bureau continues to grow in importance with each year. Here again the work of this bureau is at the service of any organization desiring to avail itself of the bureau's assistance. Speakers can be secured for addresses on infant mortality, medical school inspection, pure water, pure food or any other subject that may at the time engage the attention of the community. Additional speakers on any important subject will be welcomed. Any local organization can arrange for a public meeting and secure a speaker. The funds at the disposal of the speakers' bureau, while not unlimited, are ample to meet all demands for the present.

The next activity of the Council was the organization of a bureau of literature. Series of pamphlets on the most important subjects have been or are being prepared for distribution to those interested. Pamphlets for the protection of medical research, the conservation of vision, on general health topics, and on medico-legal and legislative questions have been prepared. Several other series are now in process of development. A single pamphlet or a series of pamphlets on cancer and its prevention can be issued by the Council without expense, provided the right kind of material can be secured.

Other plans for future development involve a lantern-slide loan bureau, a bureau of exhibits and charts, and other methods for public education.

While inaugurating these methods at once in the immediate education of the public, the most important and fundamental work of the Council at present is the investigation

of the public health situation in the United States. In addition to carrying on the activities mentioned above, the work to which the Council has decided to devote itself during the coming year is the preparation of a report on public health activities in the United States, considered under four heads, namely: Federal health activities; state health activities; municipal health activities, and private organizations. We hope to publish, by the end of the coming year, a report showing exactly what the federal government is doing for public health, and what other national governments are doing, by way of comparison; what the various state boards of health are actually doing, as shown by a personal survey by a competent authority; what is being accomplished by state boards of health, and how much it is costing; what is being accomplished by municipal departments of health, and what it is costing; what is being done by voluntary organizations, and what duplications and overlapping exist; who is paying the expenses of these organizations; what the total cost is, and what is being accomplished in proportion to the cost. Such a survey of the entire public health problem in this country has never been undertaken. When completed, it will shed light on the subject and will serve as a basis for future plans.

In addition, the Council has established a medico-legal bureau, in charge of a competent attorney, in which is being taken up the study of legislative conditions and public health legislation throughout the United States, with a view to formulating model laws on the most important subjects relating to public health, and so guiding public health legislation in the most productive channels necessary, without crowding our statute books with innumerable unenforceable laws.

Such being the general plan of the Council, the question now recurs as to the specific problem of public health education on cancer. What can the Council on Health and Public Instruction of the American Medical Association do to enlighten the public on this subject? The answer is obvious. We can place at the disposal of the American Society for the Control of Cancer and the Committee of the Clinical Congress of Surgeons of North America all of the resources of the Council on Public Health Education. Through the press bulletin, suitable material on this subject can be placed in the hands of five thousand editors without any cost to the Society or the committee. Through the speakers' bureau, addresses can be given to the public on cancer and its menace. Through the bureau of literature, local pamphlets and leaflets on this subject can be distributed. Later on, through the lantern-slide bureau and the bureau of exhibits, material on cancer and its control can be placed before the public. The agencies at work on this problem at present are the American Society for the Control of Cancer, the Committee of the Clinical Congress of Surgeons of North America, and the Council on Health and Public Instruction of the American Medical Association.

The work which needs to be done seems also to be threefold and to be peculiarly adapted to these three organizations. The first thing is to interest the public, and especially the wealthy and influential public, in the problem of the control of cancer. This is a movement for the public welfare, and there is no reason why the public should not assume part of the expense. This is the work for which the recently organized Society for the Control of Cancer is admirably adapted.

The second necessity is the careful investigation of the entire problem of cancer, its age, race, and sex incidence, its relative frequency in different occupations and locations, and all of the clinical facts connected with its appearance. There is to-day in the records of our different hospitals throughout the country an enormous mass of undigested material on this subject. This is clearly a clinical and surgical problem.

The third requirement is the distribution to the public of the results of such an investigation. This is obviously a task for the Council on Health and Public Instruction of the American Medical Association, representing as it does the organized profession of the entire country. Through its machinery, it can, without any additional expense, place

before the public any information which may be desired on this question.

The division of work which suggests itself to the careful student of the situation is this: Let the American Society for the Control of Cancer devote itself to interesting the public, especially the wealthy and influential women of our country, in the importance of the campaign against cancer and the necessity for personal support. Let the Committee of the Clinical Congress of Surgeons of North America take up the clinical side of the problem and the collection of data based on the clinical records of our hospitals. Let the Council on Health and Public Instruction of the American Medical Association, through its press bureau, its speakers' bureau, its pamphlets, and other agencies, place before the public the facts on this subject as an authoritative utterance of the organized medical profession of the United States. Such a program is concise, definite, and practical, and insures the co-operation of all forces in the field in the solution of the problem, and the control, or at least the marked reduction, of cancer in America.

CONGENITAL PYLORIC STENOSIS [1]

By ROLAND HILL, M. D., C. M., Saint Louis

RECENT studies of congenital pyloric stenosis have shown it to be a disease of much importance. Until the past few years these cases were treated as cases of marasmus, and the true pathology of the condition remained an unknown factor.

The frequency of occurrence of this condition is hard to estimate, as the statistics on this point are very meagre, but observations made at the Bethesda Hospital by Dr. T. Wistar White of St. Louis, showed five cases originating in one thousand babies. This estimate of one case in every two hundred babies seems to be fairly accurate as to the frequency of the disease.

The pathology of the condition consists primarily of great enlargement and thickening of the pylorus, caused by hypertrophy of the circular muscle. This causes an obstruction of the pyloric opening that may be more or less complete. The enlargement is about the size of the last joint of the thumb, is smooth, non-adherent, and usually can be palpated through the abdomen. The stomach becomes very much enlarged, and the intestines small and shriveled.

Scudder holds that the obstruction is an anatomic one and not dependent upon physiologic causes. Its cause is unknown, but the heredity factor seems to be prominent, as two of our cases occurred in families where the condition had occurred before.

The age at onset of the symptoms of this disease is usually between the third and sixth week of life. The symptoms vary according to the degree of obstruction, and it seems certain that conditions exist varying from slight obstruction (the spasmodic type) to complete obstruction where a fine probe can hardly be pushed through the pyloric opening. Usually we have in these cases a history of a normal child until it is between three and six weeks old, when the manifestations make their appearance.

The symptoms of the disease may be considered under four heads: 1. Vomiting; 2. Constipation; 3. The gastric waves of contractions; 4. Tumor. The first symptom to attract attention is the vomiting. At first this is hardly sufficient to demand special attention, and may be temporarily improved with a change of food. Any improvement, however, will be temporary, and the vomiting soon becomes more aggravated than ever. The vomiting is distinctly projectile. The propulsive force is at times so great that a child of three months, lying on its side, has been seen to eject the contents of the stomach a distance of three feet. Occasionally the child may not vomit for several minutes after

[1] Read before the Western Surgical Association, December 20, 1913.

taking food. In the latter stages of a severe case he ejects a part or all of every feeding.

The loss of weight is very rapid. The constipation is most marked, and in severe cases may be practically absolute. Mucus alone may be found in the stools. The urine is scanty and dark in color. The appearance of the child is like that in marasmus. The face is wrinkled and the tongue and the mouth dry.

On inspection the upper part of the abdomen is found to be enlarged and the lower part narrow and empty. The outline of the stomach can frequently be seen reaching as low as the umbilicus, and on palpation gives a sense of muscular resistance greater than that of a distended colon. The muscular or gastric waves soon make their appearance. These are pathogonomic of the condition. These waves are due to peristaltic contractions of the gastric muscle. These contractions may manifest themselves in a rounded eminence rising at the left costo-chondral border where it remains a short time. Usually, however, they manifest themselves in waves passing across the epigastrium and disappearing on the right side. Sometimes three such waves are in sight at one time. They are rarely more than one inch in height. As a rule the waves occur after taking food, but may often be brought on by irritating the skin of the abdomen in the gastric region.

The enlarged pylorus may readily be palpated in the disease. It occurs as a smooth rounded mass about the size of the end of the thumb.

The diagnosis in a typical case is easily made, as the presence of tumor, the gastric waves, the malignant vomiting, so to speak, and the marked constipation, make the picture clear. The presence of enteritis and also of brain lesions in their early stages may tend to obscure the diagnosis. In the early stages the passage of a tube and recovery of retained milk is a valuable diagnostic aid.

The treatment of congenital pyloric stenosis may be considered under two heads: 1. Medical; 2. Surgical. In all our cases medical treatment had been thoroughly tried, and in several it had been persisted in so long that surgical measures offered only a long chance. Two cases coming in the past year were considered so hopeless that after being admitted to the hospital the pediatrician in charge considered it useless to seek surgical relief, and they died in a few days after admission.

The medical treatment consists in feeding by a tube. The stomach is washed out and the food inserted through the tube. Children will often retain food given in this way in the spasmodic cases where they will eject it if swallowed. In some of these cases nutrient enemeta of whey or other foods give temporary relief.

The question of when to operate in these cases is a vital one. Scudder states that an operation is indicated in all cases where a distinct tumor is palpable, and also in those cases of spasmodic variety where, under medical conditions and treatment, conditions become very grave. Lowenburg states that in determining whether or not to operate in these conditions we have three factors of importance to consider; 1. Weight; 2. Strength; 3. Character of the constipation. He gives the following rule: If a small amount of food is retained and the weight remains stationary, or there is a slight weekly gain, or if the strength does not seem to be ebbing away, and if with this we have an occasional large bowel movement, we are justified in waiting even if vomiting persists. If no food, or very little food is retained, with loss of weight and increasing constipation, patient should be operated upon before he becomes too weak.

When these cases are studied from a surgical standpoint, there are several important factors to be considered. Infants stand the shock of operations badly. They are prone to infections, and the reparative power is so slight that the wounds may simply fall apart when one would expect them to be thoroughly healed. The operations recommended in these conditions are Loret's operation or divulsion of the pylorus, gastroduodenostomy or pyloroplasty, and gastrojejunostomy. The first two of these operations have almost been discarded as being far inferior to the posterior gastro-enterostomy.

Several points regarding the preparation and operation are worthy of note. None of the very strong antiseptics have been used in our cases, simply thorough cleansing with

soap, sterile water, and alcohol. Ether is the anæsthetic of choice with babies, and a trunk of oxygen should be available. The incision is best made to the left of the median line and rather low because of the large size of the liver. The usual Mayo-Moynihahn operation is done. In the infant, however, several points are to be carefully observed. The bowel is about three-eighths of an inch in diameter and is so fragile that the least undue tension will cause the stitches to tear through like tissue paper. The finest needles and suture material are to be employed. Fine chromic catgut may be used for the inner layer of sutures, but I think fine silk, about 00 in a No. 10 milliner's needle will be found the most suitable. The bowel is usually so shrunken that every care must be taken to avoid a kink. A kink caused the death of my second case.

The results obtained by treating these cases surgically were at first anything but satisfactory, but increasing experience, earlier recognition by the pediatrician, and operative intervention before the vital powers of the child too far exhausted, has led to some most brilliant results in this comparatively new field. One author reports that the statistics collected from 1898 to 1905 showed a mortality of 46.05 per cent. Haines of Cincinnati analyzed the records of 129 cases. In this series divulsion of the pylorus was done twenty-nine times with fourteen recoveries. Mortality 51.07 per cent. Gastro-enterostomy, seventy-six cases with thirty-five recoveries. Mortality 52.1 per cent. Pylorectomy in one case with a fatal result. F. S. Bunte, Cleveland, reports seven cases with four recoveries — all operations performed by anterior gastro-enterostomy. Statistics by Scudder show that he has performed fourteen of these operations with one death. Richter of Chicago reports twenty-one cases operated upon with only three deaths, while Stillman of San Francisco reports a group of ten cases operated upon with only one death.

The cases of congenital pyloric stenosis that have been referred to me for operation have all come from pediatricians of broad experience who draw their work not only from St. Louis, but from a large surrounding territory. I have operated upon ten of these cases — five have recovered and five died. This high mortality is due to two factors — faulty technique in one, perhaps two of my early cases; and almost hopeless complications in the other three. One had a meningitis develop a couple of days after operation, and two had intense jaundice at the time. The jaundice cases acted peculiarly. One lived eleven days and the other five days. Both died in the same way from the tissues simply falling apart, as nature had not made any efforts at repair.

1. Detailed histories of my cases are as follows:

CASE 1. My first case is that of H. W. P., Jr., born September 14, 1911, weight 8 pounds. The child was breast fed and seemed to get along well until fourteen days old, when he cried and vomited after each feeding. The attending physician said it was indigestion and had him taken off of breast milk and put on barley water, rice water and albumen water in succession with no result.

Child continued to vomit; his bowels had not moved except with the aid of castor oil or an enema, when the movement was black and scanty, containing a great deal of mucus. The condition gradually became more aggravated until October 19th, when a posterior gastro-enterostomy was performed. At the time of the operation the weight was 6 pounds and 13 ounces.

The child improved immediately and the second week gained a pound. At six months he weighed 13 pounds and at seven months, 13¾ pounds. At one year his weight was 20 pounds; at two years, 26 pounds. He seems to be as strong and active as any other child.

CASE 2. Virginia S., born November 26, 1911. Parents healthy. The parents have one child living, four years old. Two years ago a baby died of symptoms identical with the present case. Apparently healthy at birth. It thrived until three weeks old when vomiting began, and death occurred when six weeks old. No diagnosis was made.

Present case. The child was normal at birth. There was no more spitting up than in any ordinary baby until December 23d, when four weeks old. December 25th, parents became alarmed at severity of vomiting. As described by mother, "The vomiting was violent and often was greater in quantity than previous feeding." Baby was in poor condition; prostration, slight fever, peristalsis of stomach visible and tumor palpable.

The child was removed to the Bethesda Hospital and lavage begun. The vomiting decreased, but a large proportion of food was retained in the stomach and removed by washing. The child gradually

became worse and operation was decided upon. A posterior gastro-enterostomy was performed December 30th. At this time the weight was 6 pounds and 14 ounces.

This failed to give relief and obstruction was feared, and abdomen reopened in 36 hours. A kink was found in the jejunum owing to a misplaced stitch. The baby died January 2d.

CASE 3. C. O., born March 28, 1912. The family history is uninteresting except that this is the sixth child in the family, five of whom are living. One child died ten years ago at the age of six weeks. It was a healthy baby at birth and did well for two weeks, when it was taken with vomiting and died of inanition after four weeks' illness. This was probably a case of pyloric stenosis.

The history of the present case is that the baby, born March 28th, weighed ten pounds. She did well for three weeks, but on April 18th was taken with severe vomiting; bowels moved frequently and movements were very scant. A tumor could be palpated at pyloric region and muscular peristalsis was visible.

The child was breast fed until April 22d, when Eskay's food was tried. She retained several feedings the first day and also some the second day, April 24th. April 25th vomiting was most persistent and weakening. April 26th temperature was 99.5°. Dr. Saunders saw the case at this time and started lavage and feeding with peptonized milk. In the first twenty-four hours of this treatment, 11¼ ounces were retained, next twenty-four hours 7½ ounces were retained. After that not more than one-half ounce of each feeding retained.

Child lost very rapidly April 22d. when sick four days. Weight was 10.43; April 28th, 9.12; April 29th, 8.5, showing a loss of weight of one pound and nine ounces in thirty-six hours. The temperature was normal from April 18th, when sickness commenced, until April 26th. It then went up to 103 and continued to run 100–102 until after operation.

Operation. Posterior gastro-enterostomy performed April 29th, 5 P. M. The patient was treated with protoclysis and lavage. After midnight, mother's milk was given and child began to retain it. Following this there was rapid recovery. The child took the bottle in four days, vomiting gradually subsided; stools increased in amount, and the temperature became normal in five days; the decline being gradual. At the end of the first week it was found that the child had gained three ounces. During the second week she gained six ounces. From this on, recovery was very rapid. On December 11, 1913, the mother reported the child weighing 25 pounds at 20 months. Child is extremely active and enjoys splendid health.

CASE 4. Chas. G. L., male child, born May 10th, weight 8¼ pounds. The child was normal, except for a slight jaundice, until May 26th, when the characteristic signs of pyloric stenosis developed. The vomiting was projectile, constipation marked, gastric waves prominent, and a tumor palpable. The loss in weight was rapid. Jaundice was very marked. Patient referred for operation. Posterior gastro-enterostomy performed June 1, 1912. Its weight at the time was 5 pounds. Child did well for a week and then developed convulsions and died June 11, 1912.

Examination showed that the tissues had simply fallen apart both at the new opening and the abdominal wound.

CASE 5. Helen W., born June 24, 1912. The child was normal for five weeks when the characteristic symptoms of pyloric stenosis manifested themselves. Tumor palpable. Weight when admitted to the hospital, 6 pounds, 7 ounces, July 21, 1912.

Posterior gastro-enterostomy performed. Feeding in one drachm doses began six hours after operation. This amount was rapidly increased. The baby did well and was discharged cured August 10th.

CASE 6. J. E. N., born June 25, 1912, weight 8 pounds. The child was normal until July 21st, when the characteristic vomiting, gastric waves, and constipation made manifest. A tumor could not be palpated. The loss of weight was rapid. Severe jaundice existed as a complication.

Posterior gastro-enterostomy performed July 28th; weight at time, 5 pounds. The child did badly after the operation, and died August 1st. In this case the wound simply fell apart. This falling apart of the wound characterized both of the cases in which jaundice existed, as the reparative power seemed to be absolutely lacking. This was a case of the spasmodic type, as the pylorus was very little thickened and the opening was adequate.

CASE 7. Henrietta L. C. of Fort Smith, Ark., was born July 24, 1912. At birth she weighed eight pounds. Her weight increased to 11½ pounds, and child was normal until she was between four and five weeks old, when the projectile vomiting and other signs of pyloric stenosis developed. Loss of weight was gradual. She was brought to St. Louis for operation October 4, 1912. Tumor was well marked and emaciation was extreme. The child was then ten weeks old, and weighed five and three-fourth pounds.

Posterior gastro-enterostomy was performed. Anæsthetic, ether. Child fed on mother's milk. It never vomited after the operation. Gained eleven pounds in the next twelve weeks. On December 6, 1913, the father reported the child in perfect health and weighing twenty-four pounds.

CASE 8. N. B., was referred for operation, April 8, 1913, at the age of four months. The early history was not obtainable. The meager history given was that symptoms of pyloric stenosis had developed at the age of five weeks and had been persistent although a tumor was not palpable. When referred for operation, the child had a running ear and a temperature of 100. Its weight at the time was 7 pounds 15 ounces.

Posterior gastro-enterostomy was performed and the child did well for three days and then developed meningitis from which it died at the end of a week.

This case was simply one of spasm of the pylorus and a true stenosis did not exist. Examination of the cerebrospinal fluid showed that the case was simply one of meningitis from the ear infection.

CASE 9. Herbert H., born June 15, 1913; weight 9 pounds. This increased to 11½ pounds by the first of July. July 6th, commenced to have the characteristic vomiting of pyloric stenosis. This was accompanied by the other characteristic signs, including tumor. The loss of weight was rapid. From July 8th to 11th, the child lost 1½ pounds. Conditions became gradually worse until July 26th, when child weighed 5 pounds 8 ounces. Conditions were so grave that it was thought if a gastro-enterostomy were attempted the child would die on the table. In this case divulsion of the pylorus was done by means of a forcep passed through a small opening in the stomach. The pyloric muscle could be felt to give way. Four ounces of water were inserted into the bowel by means of a catheter passed through the pylorus. Conditions improved for the next few days then the child became worse and died August 3, 1913. The abdominal wound simply fell apart, and it was found that the pylorus had contracted down again.

CASE 10. Mallory P., a twin born October 11, 1913. The child was premature and at birth weighed only 4 pounds and 2 ounces. Friday, November 11th, the severe vomiting commenced, and the gastric waves became prominent. Constipation almost absolute. A tumor was palpable. Operated, November 14, 1913. Child at the time was pulseless at the wrist and had been so for more than 24 hours. Its weight was 3 pounds and 15 ounces. Its temperature was subnormal. Posterior gastro-enterostomy performed. Next day and for several days following he had several mild convulsions, would occasionally cry out with pain, but for the most part was perfectly still; eyes partly open, and unable to swallow. All food was given through a tube, beginning with a few drachms of water almost immediately after operation (within two hours). Mother's milk was given next day, at first one-half ounce every two hours, and increased to one ounce. One-half ounce of water with three per cent cane sugar was given the alternate hour. Practically all vomiting ceased, and stools became normal. It was ten days before the child could swallow, and more than a week before it could close its eyes. Gain in weight was slow, only about three ounces the first two weeks. After this the child began to improve rapidly. It gained four and one-half ounces the third week; twelve and one-half ounces the fourth week. The fifth week the gain was one pound for the week.

This is the smallest child of which I can find any record of having been successfully operated upon for this disease.

In conclusion I wish to add that all of the cases submitted to operation should be fed upon mother's milk. They should have the care of a nurse thoroughly trained in pediatrics, and a pediatrician should have charge of the feeding. These things are, I believe, absolutely necessary if the best results are to be obtained. In regard to the application of surgery to these cases, I believe I am justified in saying that the operation is justifiable if it can be shown, first, that a tumor is present; second, that the operative treatment is attended with a mortality as low or lower than the medical treatment by lavage and diet; third, if with an equal or lower mortality, it can be shown that surgery gives immediate results and saves parents the prolonged suspense of doubtful treatment that may demand operative relief in the end.

In regard to the mortality in these cases, it was high in the early series of cases in the hands of different operators. With an increased experience, however, it has come down until it is lower than medical treatment in the most skillful hands.

The second point is easily answered.

In the doubtful cases treated by lavage, the outcome is in doubt for several weeks at least; the treatment is nerve-wrecking and the outcome uncertain.

Surgery, on the other hand, yields results almost instantaneous, and a child that to-day is crying, vomiting all nourishment and the picture of marasmus, may in a week's time present a condition of rapid convalescence and contentment.

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OPERATIVE TREATMENT FOR MALFORMATIONS OF UTERUS AND VAGINA [1]

By J. M. MUNRO KERR, M. D., Glasgow, Scotland
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ALTHOUGH gynecological surgeons frequently encounter malformation of the reproductive organs, for they are much more frequent than the general medical public suspect, there are singularly few contributions to the surgery of such malformations. There are, of course, many contributions relative to individual varieties, but with the exception of Goullcound's thesis, "Du Traitement des malformations utérines justiciables de la laparotomie," [2] I can find few contributions which deal with the subject in general.

The time, therefore, has come when we should consider a little more than we have done in the past how these malformations may be remedied or improved.

I propose to consider malformation under the following heads:

A. Where fusion of the Müllerian ducts has occurred, but development of the uterus has been arrested.

B. Where the Müllerian ducts are fused, but the two halves of the uterus are divided by a more or less complete septum.

C. Where the two Müllerian ducts are more or less imperfectly fused.

D. Where the deformity affects the vagina more especially.

A. WHERE FUSION OF THE MÜLLERIAN DUCTS HAS OCCURRED BUT DEVELOPMENT OF THE UTERUS HAS BEEN ARRESTED.

Infantile uterus. In the simplest of all malformations, the infantile uterus, I have never been able to secure a satisfactory menstruation nor have I ever seen a pregnancy occur. I have sometimes seen a small uterus respond to such local treatment as dilatation, electricity, repeated curettage, etc., and a more satisfactory menstruation and even a pregnancy occur, but the true infantile uterus is, in my experience, a hopeless organ to remedy. In many cases it is even worse than that, for it is frequently the cause of great discomfort to the possessor. We are familiar with the extreme dysmenorrhœa frequently associated with the condition and which in former years led surgeons to remove the ovaries, but which is now rightly dealt with by hysterectomy.

Uterus fœtalis. In the more extreme varieties, such as the uterus fœtalis, menstruation is generally absent. If present it is late in making its appearance, only occasionally occurs, and is very scanty. It is often associated with dysmenorrhœa, but in several cases which I have had under my care there was no dysmenorrhœa or menstrual discharge. I have seen the condition in women of specially good physique as well as in women delicate, small, and ill-developed. The external genitalia and the ovaries are generally poorly developed. Nothing can be done for such cases, but operative interference is only indicated when extreme dysmenorrhœa is affecting the general comfort and health of the individual, and here again total hysterectomy is preferable to oöphorectomy.

Uterus rudimentarius. A more pronounced degree of malformation in which the uterus is rudimentary — uterus rudimentarius (encavatus or solidus) — is an error of development of a much earlier date. In this variety the uterus is small, generally with a single small cervix and two elongated tubular bodies; in extreme cases there may be no cervix. In this variety of malformation the more rudimentary the uterus the less likely is there to be any pain and discomfort of a periodic nature, but in some cases, both where the tubular bodies are solid and where they are canalized, severe periodic pain has necessitated complete removal. In two cases recently examined the women were well de-

[2] Ann. de Gynéc., 1912, Oct., Nov., Dec.

[1] Read before the Obstetrical and Gynecological Section of the International Congress, London, August 1913.

veloped and with good-sized breasts. The vagina is often absent or if present is small. In one or two cases the glands have been well-developed testicles and not ovaries. A case recently operated upon by Russell Andrews was of this nature, and yet the individual appeared to be a well-developed woman. This fact is peculiarly interesting in connection with the internal secretions and the influence these have upon the growth and development of the individual.

Here again nothing can be done for the condition in the way of making a healthy functionating organ, but when the vagina is absent a canal may be artificially made. We shall refer to this later when speaking of malformation of the vagina.

Atresia cervicalis. From the infantile uterus with its subdivisions we naturally pass to the cases in which the cervical canal is obliterated in its whole extent or at the site of the internal or external os.

Patients with these conditions may suffer no discomfort if there is no menstrual accumulation (hæmatometra) or if there is no periodic uterine contractions, but they will suffer pain if a menstrual discharge gets pent up with the formation of a hæmatometra or if there is active uterine contraction of a periodic character.

In dealing with such cases surgically it is obvious that little benefit will be secured by establishing a cervical canal if there is no evidence of periodic pain or uterine hæmorrhage, for the women are hopelessly sterile. But, on the other hand, if there is evidence of an accumulation of blood in the uterus some plastic operation on the cervix may result in the relief of the periodic pain by allowing a free escape of menstrual blood. In a few cases pregnancy even may occur. Naturally, the best results will be secured in those cases where the atresia is located to the internal or external os. In the cases where plastic operations are impossible hysterectomy offers the only cure.

Atresia of internal os. We are all familiar with stenosis of the internal os — with those cases in which the sound passes readily through the cervix until it reaches the internal os, and where, with little force, we manage to get it pushed through and kept patent by repeated dilatation or a stem pessary. Personally, I have not encountered a case where there was absolute obstruction limited to the internal os, and so I think it must be very rare indeed.

In dealing with cases of genuine atresia of internal os, different methods may be employed. A common practice was to force a passage with sound or metrotome and keep it patent by means of a stem pessary. But surely with our present surgical knowledge such a method is crude.

A very ingenious suggestion is the one made and actually employed by Goullcound and termed by him "trachelostomie." It is performed as follows: The abdomen having been opened and the bladder pushed down, the uterus is split up the middle line. The obstructing tissue at the os internum is then excised, the uterine and cervical edges of mucous membrane are stitched, and a stem placed in the cervix. Finally, the two edges of the uterine wound are stitched together. The illustration explains the manner in which the operation is performed.

Goullcound mentions a case reported by Engstrom[1] where the latter opened the uterus and established a canal, dilated it and pushed down a piece of gauze through it into the vagina. One tube distended with tea colored fluid was removed.

Personally, I think where there is any thickness of tissue it would be better to push the bladder well off the cervix and excise, by transverse incisions, the obstructing ring of tissue. Finally, an end-to-end anastomosis of cervix to body should be made much in the same manner as that suggested by Mayo[2] for dealing with myomata of the cervix.

One thing, however, is of prime importance and that is to open the abdomen in the first instance in all the more complicated cases of atresia of vagina or cervix. In reading over the literature of the subject one is struck by the frequent disasters which have followed dissections and tappings from the vagina. Most recent papers, as, for example, those of

[1] Zentralbl. f. Gynäk., 1899, p. 923.

[2] Surg., Gynec. & Obst., Feb., 1911, p. 100; Ann. de Gyn., Nov. 1912, p. 700.

Veit[1], Lichtenstein[2], Goullcound, support this procedure.

Atresia of external os. We are all familiar with this condition in obstetrical practice, and have dealt with it by making a crucial incision when the cervix was obliterated and the presenting head stretched the cervical canal. Some of us have seen the uterine contractions overcome the obstruction and carry away part of the thinned-out portio vaginalis. In gynecological practice, however, it is not common to encounter it and very difficult to distinguish it from a cervix completely obliterated. When the condition is suspected and a hæmatometra exists a trochar and cannula may be employed with great care and the portio punctured at its apex. If the accumulation of blood is readily reached one will conclude that only the region of the internal os is obliterated, but if the hæmatometra cannot be tapped, or only tapped with great difficulty, one concludes that the whole canal of the cervix is atresic. Where an atresia exists only in the neighborhood of the external os and a good-sized trochar has been inserted, the operator should cut a circular wedge from the lowermost portion of the cervix and unite the mucous membrane of the canal with the mucous membrane of the vaginal surface of the portio.

Atresia of the whole cervical canal. In this condition our difficulties in establishing a satisfactory canal are much greater. This is especially the case in this variety because the upper part of the vagina is often atresic. The older methods were to attempt to establish a communication by knife, trochar, and cannula from below. This, as I have said before, is crude, and as the recorded cases show is attended with great danger to the patient.

A somewhat safer proceeding was that adopted by Ludvig[3] in a case of hæmatometra with a non-canalized cervix. He opened the abdomen and found no distention of the tubes, only some free blood in the pouch of Douglas. He then opened the uterus and pushed a trochar and cannula through from the uterus into the vagina. In criticizing the proceeding Wertheim mentioned a case where he had established a fistulous opening between the lower part of the body and the vagina by suturing the uterine body to vagina (ventrofixation). A somewhat similar proceeding was adopted by Halban[4] who fixed the fundus to the vagina.

It is not surprising that operators in recent years should have been abandoning such crude methods, and should have been attempting to establish a permanently patent canal by removing the intervening tissue and resecting and uniting the two ends by means of sutures. As we shall see when atresia of the vagina is under consideration, this method of dealing with gynatresia is not difficult when the atresia is confined to the lower third of the vagina or where the obstruction involves only a small portion of the cervix and vault of the vagina. But if there is a considerable portion of tissue intervening involving cervix and upper third of vagina it is extremely difficult to establish an end-to-end anastomosis and a satisfactory utero-vaginal canal. This was well seen in the case recorded by Cohn[5]. Cohn failed to establish this union of the two ends and was finally compelled to perform hysterectomy. Without doubt the ideal procedure is to open the abdomen, examine the adnexa, and separate off the bladder until the vaginal rudiment is reached. This is infinitely safer and more surgical than dissecting one's way up from below without knowing what is the condition of the adnexa.

B. WHERE THERE IS FUSION OF THE TWO HALVES OF THE UTERUS, BUT A MORE OR LESS COMPLETE SEPTUM DIVIDES THEM.

1. *Septum complete.* (Uterus septus or uterus bilocularis.) In this variety of malformation there appears to be little disturbance of general health or menstruation unless there is atresia of one cervix. Hæmatometra in this variety is very rare. Parturition too is frequently easy, although by no means always so.

[1] Prakt. Ergeb. der Geburtsh. u. Gynäk., 1909.
[2] Zentralbl f. Gynäk., 1912, p. 225.
[3] Zentralbl. f. Gynäk., 1900, p. 653.
[4] Ztschr. Geb. u. Gynäk., 1903, xlix, 17.
[5] Zentralbl. f. Gynäk. 1908, p. 1593.

A very striking example of dystocia caused by this malformation is the one recently described by Bethin[1] where cæsarean section was necessary. The author in his paper is more concerned in discussing the advantages of cervical cæsarean section than in considering the most suitable operation for this particular malformation. We are inclined to think from the description of the case and the illustrations which accompany his most interesting paper that the operator might have employed a median longitudinal incision, and removed the whole septum after extracting the child.

The most natural course to pursue in cases of this nature which call for operative interference during pregnancy and parturition is obviously removal of the septum after splitting open the uterus. From recorded cases we are quite convinced this might generally be done without much difficulty.

As regards the non-gravid uterus matters are quite different. We believe that in these cases the septum can best be reached and removed in the following manner: Open the abdomen and examine the uterus and adnexa. Then make a transverse incision across the uterus at the lowermost part of the body. Just divide the uterus to about the extent of two-thirds, turn back the two halves of the uterus, and by that means one can readily reach the septum of body and cervix and remove it with scissors. Pack some ribbon gauze into uterine body and push down the end through cervix. Then suture divided uterus with catgut. Such an operation could be performed either per abdominem or per vaginam. Personally, I think the abdominal route is always the best, and especially in dealing with malformations.

Some critics may contend that this variety of malformation so rarely disturbs menstruation or parturition that it is unnecessary to deal with it. I admit that there are many cases where women with uterus bilocularis have had repeated normal parturitions, but if you search carefully the literature you will find a considerable number of cases of abortion, premature labor, placenta prævia, dystocia, post-partum hæmorrhage. I consider, therefore, that it is always desirable to remove the septum in a uterus bilocularis. Strassmann[2] gives an interesting account of two cases, in one of which the removal of the septum was attended by most gratifying results.

As regards those extremely rare cases in which one half is the seat of a hæmatometra, I can conceive of no better procedure than the one I have suggested; viz., approaching the septum by a transverse incision just above the isthmus. It would be extremely difficult to excise a hæmatometra of this eariety, but fortunately all that is necessary in this complication of uterus bilocularis is to remove the septum. This being removed there can be no further accumulation of blood in the atresic half, and pregnancy and parturition should not be unduly disturbed.

I feel confident, then, that this variety of malformation will ultimately be satisfactorily dealt with in some such manner as has been indicated.

Partial septum. (Uterus subseptus.) In cases of this variety, where the septum is limited to the fundus, parturition may be disturbed, but menstruation and general health are not affected unless there is some other complication. In such cases the child may be born without much difficulty, but oblique presentation of the child and retention of placenta are not infrequent. Such complications I have seen upon three or four occasions, and all writers refer to the frequency of these occurrences.

Judging by the recorded cases and those which I have seen, I am not convinced that operative interference is necessary in this variety of malformation. But it would be a very simple matter to remove the septum in the manner already recommended for uterus bilocularis.

A more radical proceeding would be to resect the uterus as Strassmann has recommended.

Where the septum is limited to the lower part of the *uterus subseptus cervicalis* miscarriages seem to be unusually frequent and

[1] Monatschr. f. Geburtsh. u. Gynäk. 1912, xxxv, 162.

[2] Berl. klin. Wchnschr., September 9, 1912.

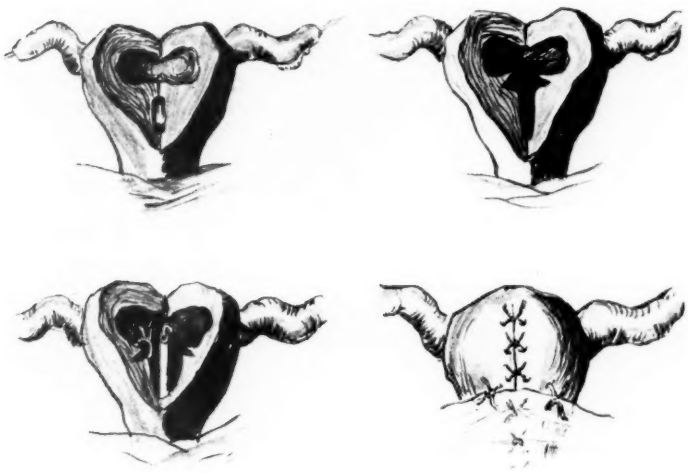


Fig. 1

dystocia naturally may be extreme. There are a considerable number of cases recorded where the delivery has had to be terminated by version, craniotomy, or cæsarean section. The diagnosis is not difficult. In the non-gravid, by passing a sound through each cervical canal one can tell the extent of the septum. Neither should it be difficult in the parturient, for if the cervical septum is divided and the cervix is dilated one will be able to tell by anæsthetizing the patient and passing one's hand into the vagina and the fingers into the uterus whether or not there is any septum in the body. In the pregnant, however, it will generally be necessary to wait until labor occurs.

The treatment of the condition is simply to excise the septum. In the non-gravid this might be done from the vagina. The bladder could be pushed off the cervix and the uterus divided as in vaginal cæsarean section. The septum could then be readily excised, the uterus plugged with gauze, and the uterine wound sutured.

If the condition has to be dealt with during labor it is unnecessary to divide the cervix, for the septum can be divided by scissors under the protection of one or more fingers passed through the dilated cervix.

C. WHEN THE TWO MÜLLERIAN DUCTS ARE MORE OR LESS IMPERFECTLY FUSED

Uterus cordiformis—uterus arcuatus. This is the simplest variety of this group of malformations. The depression at the fundus varies, and not infrequently there is a septum more or less marked. Where the depression is very slight and the septum well marked, the malformation really assumes the form of the uterus subseptus, while at the other extreme where the depression is deep and the two bodies markedly separated it passes into the uterus bicornis unicollis, the next variety to be considered. Now, it is important to appreciate this, for the surgical treatment differs, if surgical interference is necessary, according as the uterus cordiformis assumes the former or the latter type. This will be best appreciated by considering the surgical treatment which has recently been proposed and carried out by Strassmann.

Strassmann's first contribution to the subject appeared in 1907[1] and his latest communication, as far as I know, appeared last year.[2] The operation recommended by Strassmann consists in suturing the two halves together after cutting a wedge out of the two

[1] Zentralbl. f. Gynäk. 1907, p. 1322.

[2] Berl. klin. Wchnschr. 1912, September. 9, 1750.

halves. It is best understood by the accompanying illustration.

In his last communication Strassmann was able to record two spontaneous births at full time. The result was most satisfactory, for the woman prior to the operation had had eight miscarriages. In the paper he mentions cases operated upon by Puppel and Truzzi.

Personally, I have seen a considerable number of cases of uterus cordiformis and uterus bicornis unicollis, and in looking back on them I believe some might have been satisfactorily dealt with in the manner described by Strassmann. I feel also quite certain of this, however, that the more nearly the uterus cordiformis approaches the uterus bicornis unicollis the more difficult will resection be. In the last case of bicornic unicollis operated upon and which I shall describe when considering that variety of malformation, it would have been futile to attempt Strassmann's operation. But I believe when the uterine bodies are incompletely divided and when there is a wide entrance so to speak into each cornu, an operation such as Strassmann has described might be carried out with great benefit to certain patients.

Fig. 2

Further, I would say this in regard to Strassmann's operation, that I am entirely opposed to the vaginal route. I feel certain it is infinitely safer to deal with these cases through an abdominal incision as Puppel and Truzzi did.

From what I have said it is obvious that resection of the uterus can only be performed in the simpler forms of double uterus so that critics might say: Is it really necessary or of much advantage to resect a uterus in such cases?

Personally, I do not agree with such critics; if one consults the literature on the subject one finds that abortions, premature births, malpositions of child, post-partum hæmorrhage, retention of placenta in one horn, and sepsis are by no means infrequent. Having had no experience of the operation, I cannot write with any authority, but I think that resection might be employed with advantage in carefully chosen cases.

Uterus bicornis unicollis. This is one of the commonest of the marked deformities which we encounter, and many cases have been recorded, particularly the variety in which one cornu is rudimentary. We are at present considering, however, the variety in which both horns are symmetrical. I have seen several cases of this variety and have twice opened the abdomen and accurately observed the malformed uterus *in situ*. The first case was not of special interest; it was a case of double salpingo-oöphoritis. The tubes and ovaries presented the ordinary appearances of this condition, so they were removed and the uterus left. The patient made an excellent recovery and was much relieved of her discomforts.

Fig. 3

But the second case was of particular interest, and was operated upon by me in a private nursing home about eighteen months

ago. The result which followed the hemihysterectomy I performed has been so successful that I make no apology for describing the case in some detail.

The case was that of a young lady aged twenty who was brought to me by her mother on account of extreme dysmenorrhœa. She was a healthy, well-developed woman, bright and intelligent. Her menstruation was occasionally slightly late, but of about the normal character as regards duration and quantity of discharge. Her mother informed me that she had been in the hands of another gynecologist for a number of years and that he had dilated the cervix and removed one ovary which was slightly enlarged. She also told me that at the operation he had discovered a double uterus and that he now proposed that the other ovary should be removed, as the dysmenorrhœa was as bad as ever. I informed the patient and her mother that I could offer no

Fig. 4

opinion until I had examined the patient under an anæsthetic. This I did and found a symmetrical uterus bicornis unicollis. I could get the sound into the right half readily but not into the left half. Asked for my opinion as regards treatment, I informed them that I was absolutely opposed to removing the other right ovary. I also informed them that I was inclined to think that the dysmenorrhœa might be relieved by removing one uterine horn, for although the pain was not limited to one side, I thought in all probability the two cornu were contracting irregularly and certainly the canal of the left half was narrower than the right. I proposed, therefore, a hemihysterectomy. A few days later I performed that operation and the result has been beyond my expectations, for she has now no pain at her menstrual periods, which are absolutely regular and normal. I see no reason why she should not marry and have children. She has a normal-sized uterus unicornis and a healthy right ovary and tube.

I feel certain this procedure is well worth considering in cases of this nature, for dysmenorrhœa is very frequent with uterus bicornis unicollis. Certainly one should try this course prior to performing hysterectomy when radical treatment is necessary. Oöphorectomy, of course, is a most undesirable proceeding.

The extreme dystocia which may occasionally occur is exemplified in Galabin's[1] case, in which cæsarean section was necessary because the child developed partly in one half and partly in the other.

Rudimentary horn. The variety of double uterus in which one horn is rudimentary is a condition so well known that it is unnecessary for me to take up time with its consideration. We are all familiar with this condition, as-

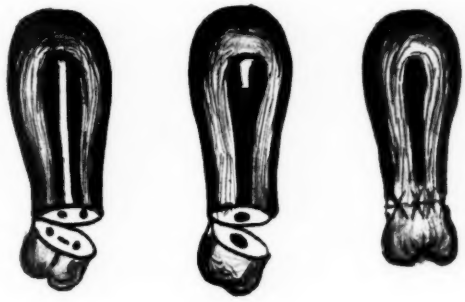


Fig. 5

sociated sometimes with hæmatometra and at other times with pregnancy. For both these complications it is frequently necessary to operate, because the former is often associated with a considerable amount of pain and the latter generally terminates in ruptures. By all of us it is now admitted that the ideal procedure is to remove the rudimentary horn and leave the normal horn behind, and so satisfactory has been this procedure that on several occasions pregnancy has occurred and continued on to term. The removal of the rudimentary horn in the two cases which have been under my care was singularly easy, and the stump was readily covered with peritoneum. Occasionally, however, the operator has found that the gravid horn has burrowed down towards the pelvis. In these

[1] Tr. Obst. Soc., Lond., xxxvii.

latter cases there may be a considerable difficulty in removing the horn. Indeed, the difficulty may be so great that the operator is compelled to remove the whole uterus, as for example in the case recorded by Wilson.[1]

Uterus didelphys. In this variety of malformation the general health, menstruation, and parturition are rarely disturbed if each half is well developed and there is no obstruction of either vaginal canal. Such cases, therefore, rarely call for surgical interference. I have seen in connection with my private and hospital practice several cases of this nature. In the two cases in non-pregnant women the condition was discovered at the time of examination, and the discomforts complained of could in no wise be attributed to the malformation. In the four cases seen in parturient women the vaginal septum had twice to be divided. A summary of these cases will be found in *Operative Midwifery*.[2]

Such complications as backward displacement or hæmatometra of one uterine half, atresia of one cervix, fibromyoma, and even carcinoma of one or both halves, have been recorded, and may arise as complication, and disturb the general health, menstruation, and parturition, but they are of extreme rarity. It stands to reason, therefore, that surgical interference is seldom necessary and that the most suitable procedure for cases in which one uterine half causes trouble is hysterectomy of the faulty half. The healthy half should assuredly be left unless it is affected by malignant disease or a large fibromyoma.

I feel certain that every one will agree with me that to attempt to form a single uterus out of two halves of a uterus didelphys would be the height of surgical folly. I cannot conceive that such an operation will ever be favored.

Uterus pseudodidelphys. A great number of cases termed uterus didelphys are really examples of pseudodidelphys. The distinction is of importance anatomically, but clinically the two conditions are the same. The treatment of the two conditions is similar, and so I may pass on to the next group of deformities.

Cohn, Rev. de Gynéc. et de Chir. abdomén, 1909.

[1] Proc. Roy. Soc. Med., Obst. Sect., 1908, i, 41.

[2] Baillière, Tindall & Cox. 2d edit., 1911.

D. WHEN THE DEFORMITY AFFECTS THE VAGINA MORE ESPECIALLY

In many of the varieties of malformations of uterus which we have been considering, the vagina is also deformed. Thus in atresia of the cervix there is frequently a complete atresia of vagina, while in the septate and double uterus the vagina is often divided by a more or less complete septum. As regards the vaginal septum little need be said, the septum is easily dealt with and can be removed without difficulty with scissors, as I have had to do on two occasions where the septum formed an obstruction to the passage of the child. There are many cases on record where a similar proceeding was necessary.

In those cases where there is an atresia of one half and hæmatometra or hæmatocolpos, the treatment will depend on the extent of the atresia. If there is a simple membrane or diaphragm in one canal, division of it is all that is necessary; but if the atresia is extensive, removal of the corresponding uterine half will generally give the best result. The problem, therefore, resolves itself into the treatment of atresia of the vagina.

The surgical problem of pronounced atresia of the vagina has long interested operators, for the great difficulty has always been to secure a canal which would not contract and return to the condition it was in prior to operation.

Now, I think we are all agreed that the older attempts to secure a permanently patent vagina by dissection from below have generally proved unsatisfactory. The earliest operative proceeding was the attempt to establish a vagina by simple dissection. In many cases the bladder and rectum were separated and a tubular space formed, but almost invariably the canal contracted in spite of every attempt to maintain its patency by dilators.

An advance upon this simple procedure was the attempt to maintain a patent canal by grafting upon the cellular tissue portions of skin and mucous membrane from the neighborhood of the vulva. Quite a number of cases of success from these methods are recorded, especially in cases where the atresia was confined to the lower third of the vagina

and the mucous membrane of labia were employed. Other devices of employing folds of peritoneum and Thiersch grafts were less successful, while hetero-grafting of skin or mucous membrane from man and the lower animals were of experimental interest, but were never extensively employed and were almost without exception unsatisfactory.

A great advance in recent years was initiated by Pfannenstiel, who pointed out the importance of opening the abdomen and determining exactly the condition of uterus and tubes before proceeding to the construction of the vagina. In the first operation Pfannenstiel brought down the cervix to a low vaginal rudiment of about 1½ cm. in

Fig. 6

depth. The canal remained patent and the women menstruated regularly.

I am not concerned here with these simple cases of atresia in which a thin membrane obstructs the canal. I propose to consider only those in which the obstructing tissue is of considerable thickness.

In dealing with such cases the operator should first open the abdomen, determine the condition of uterus and adnexa, and confirm his diagnosis of the site and extent of the vaginal atresia. Having done this the procedure to be followed will depend on the situation and extent of the obstruction.

Supposing the atresia to be in the lower part with absolutely no trace of a vaginal orifice, the operator, having emptied the hæmatometra or hæmatocolpos, should separate off the bladder as far as possible from the

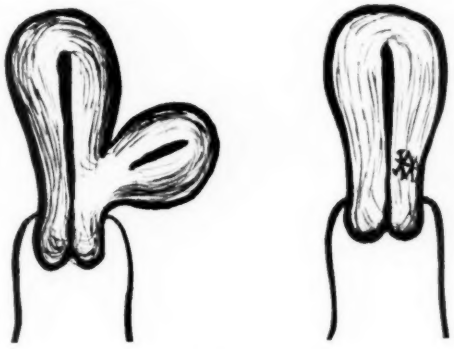


Fig. 7

abdomen and loosen the attachments of uterus and upper two-thirds of vagina rudiment. In doing this he may have to divide the uterine arteries. He should then dissect up from below and grasp the blind end of the vagina which is pushed down from above by his assistant. The vaginal sac should then be incised and stitched to the skin margin. This somewhat simplified procedure was the method employed by Pfannenstiel in a case operated upon by him in 1900 and described by Cohn.[1]

If the atresia is situated in the middle third and there exists a lower and upper vaginal rudiment, an end-to-end anastomosis of the vagina should be attempted by means of com-

[1] Zentralbl. f. Gynäk., 1908, p. 1596.

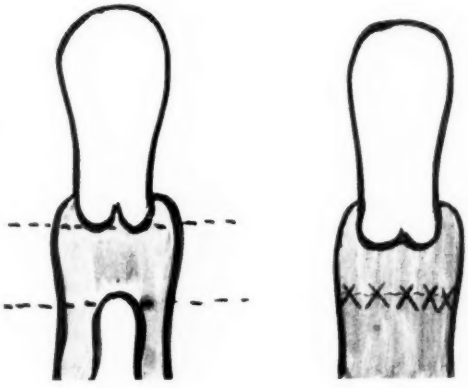


Fig. 8

bined abdominal and perineal manipulations. Should that fail, the lower rudiment must be sacrificed and the upper brought down to the skin. At first only a very shallow vagina will result, but it will deepen as the uterus is drawn upwards, as Pfannenstiel has shown. In cases where the atresia is situated in the upper part of the vagina and there is a fairly good lower rudiment, an attempt should be made to unite the cervix to the vaginal rudiment in the manner already referred to in connection with complete atresia of the cervix. Unfortunately, however, in case of this nature the cervix is often atresic and it is quite impossible to join uterus and vaginal rudiment, as was well illustrated in Cohn's case already referred to.

In cases of complete atresia with functionating uterus little can be done of a plastic nature. An extremely interesting case of this nature was one recently described by Fordyce, who ultimately found it necessary to perform hysterectomy. Had Fordyce been able to establish a communication from below it might have been possible for him to pull down the uterus and stitch it to the skin. An important point in connection with this case was the fact that Fordyce found it difficult to perform hysterectomy until he had emptied the distended uterus. I believe this is a matter of the very greatest importance in these cases if one is going to attempt any plastic operation. I should very much like to encounter a similar case. I feel certain that it is quite possible after constructing a vagina by Baldwin's or Sneguireff's method to open the abdomen again some weeks later and establish a permanent communication between uterus and artificial vagina.

This would be preferable to establishing the continuity of the new uterovaginal canal at one and the same time.

This naturally brings me to the consideration of the most recent gynecological procedure, constructing a vagina from a portion of isolated bowel.

The justification for doing this major operation, for it must be considered a major operation, is a matter of opinion, especially in those cases where there is a rudimentary non-functionating uterus; when, in other words, the artificial vagina is constructed solely for the purpose of intercourse. The morality of the question I am not going to discuss: I am simply going to put on record a case in which I performed Baldwin's operation and in which I considered I was justified in so doing. I may say I performed the operation in the University Gynecological Department of the Royal Infirmary before the Visiting Gynecological Society when they visited Glasgow in November of last year.

The woman was thirty years of age and married. She was physically well developed to all appearance. She was of normal height, well nourished, had well developed mammæ and vulva. There was, however, only the shallowest dipple marking the vaginal entrance. I detected by a recto-abdominal examination made under anæsthesia that there were two movable bodies (ovaries) placed close up against the pelvic brim. I could find no trace of a uterus. She had no discomforts in the way of menstrual molimen, abdominal pain or headache; indeed, she enjoyed perfect health. She informed me, however, that her husband threatened divorce. I explained to her the operation which I ultimately performed, and she decided to have it done. The operation was performed as follows: I opened the abdomen and isolated the most dependent loop of ileum. It was situated about a foot from the ileocæcal valve. Having done this and closed up the ends of the isolated loop, I established a lateral anastomosis between the ileum and cæcum. I now turned my attention to the perineum and dissected up between bladder and rectum. This was a matter of considerable difficulty as there seemed to be singularly little loose cellular tissue between these two viscus. Ultimately I established an opening into the peritoneum and pulled down the loop of isolated bowel. I tried to bring one end down but found that impossible, although I now believe with proper snipping of the mesentery it might not be so very difficult. I had, therefore, to bring down the loops doubled up. I then stitched it to the margin of the perineal wound. Two or three days later I opened into the lumen of the bowel.

The patient made an excellent recovery and some months after the vagina was of good depth and admitted one finger. I have not seen her for three months. She did not complain of any mucous discharge.

The operation performed was first demonstrated by Baldwin in 1904.

Phillips of Sheffield and Victor Bonney of London have performed the operation, while on the Continent and in America quite a number have been done.

Those interested in the matter will find

the subject very fully gone into by Marshall[1], Quénu and Schwartz[2], and Kroemer[3].

The other method of Sneguireff and Schubert of making use of a portion of pelvic colon I have no experience of, but it is also referred to in some detail in the papers mentioned.

[1] Tr. Edinburgh Obst. Soc., xxxvii. 224.
[1] J. Obst. & Gynec., Brit. Emp., April, 1913.
[2] Rev. de Chir., June, 1913.
[3] Prakt. Ergeb. d. Geb. u. Gyn., Heft 1, 1912.

You naturally ask what is my attitude towards these operations. At present it is as follows:

1. The operations are justifiable with a functionating uterus, for the only alternative is hysterectomy.

2. They are not justifiable in an unmarried woman with a non-functionating uterus.

3. They are sometimes justifiable in a married woman with a non-functionating uterus.

DEPARTMENT OF TECHNIQUE

A METHOD OF EXPOSING THE PELVIC PORTION OF THE URETER

By JOHN M. BIRNIE, M. D., Springfield, Massachusetts

THE method of exposing the pelvic portion of the ureter which is herein described may not be new, but up to the time that I conceived the idea, I had never seen or heard of it, nor could I find any description of the method, which is as follows:

With the patient in the Trendelenburg position a median incision is made beginning close to the pubic bone and extending upward, exposing the space of Retzius in the usual manner. No muscle fibers are cut but the recti are retracted to either side. The point where the parietal peritoneum is reflected onto the bladder is noted and care taken not to open the peritoneal cavity. Starting at the bladder, the peritoneum is wiped away toward the median line separating it from the bladder and pelvic wall, thus exposing the ureter. With retraction one gets a complete exposure of the ureter and any necessary procedures may be carried out under the guidance of the eye. Drainage, if necessary, may be instituted through the original incision or through a separate stab wound.

Since first employing this operation, several months ago, I have not had a chance to try it again, but, at my suggestion, three of my colleagues at the Springfield Hospital have employed it with complete satisfaction.

TECHNIQUE EMPLOYED IN EXCISION OF A CARCINOMATOUS URETHRA

By SIGMAR STARK, M. D., Cincinnati
Professor of Clinical Gynecology, Medical Department, University of Cincinnati; Gynecologist, Cincinnati General Hospital; Gynecologist, Jewish Hospital

ON December 3d I operated upon a woman fifty years of age in my service at the Cincinnati General Hospital.

The clinical history of the case was as follows: For a period of about one year she had been experiencing increasing difficulty, with pains on urinating. At no time was there either a purulent or bloody discharge from the urethra. About five weeks previous to the operation she noticed a "lump" in the anterior vaginal wall corresponding to the site of the urethra which rapidly grew in size and was associated with great difficulty in voiding urine.

On examination a diffuse infiltration, involving the whole urethral canal about 2½ cm. in width and extending up to the pubic arch, was encountered. "Milking" of the urethra was not followed by a discharge from the meatus. A small probe was passed with great difficulty into the bladder. The inguinal glands of both sides were only moderately enlarged. A diagnosis of periurethral carcinoma was made, which was confirmed by Dr. Paul Wooley, pathologist to the Cincinnati Hospital, who pronounced the same to be an epithelioma, by examination of a section removed under cocaine.

The surgical technique employed was as follows: A curved incision about 4 cm. in length was made directly under the arch of the pubes and continued in depth through the triangular ligament until the retropubic space was reached. From this a longitudinal incision through the vaginal wall was then made on either side of the indurated area in a posterior direction well beyond the limitation of the involved tissues. The two vaginal flaps were then deflected by dissection laterally toward the ischiopubic rami. Curved hæmostats were then placed from above downward on the tissues before they were cut through first on one side and then on the other close to the lateral wall of the pelvis, as far backward as seemed necessary. The object of this was to anticipate hæmorrhage from the branches of the internal pudic vessels coursing through the triangular ligament. This precautionary measure turned out very satisfactorily as the bleeding was almost nil. After liberation of the tumor mass, it was incised along its whole anterior surface into the urethral canal and bladder. This procedure facilitated the final removal of the remainder of the tumor through a healthy zone under ocular supervision, which disclosed the fact that the part of the bladder wall immediately surrounding the internal urethral orifice had been excised. After ligation of the vessels included in the curved hæmostats by transfixion,

the bladder orifice was sutured to the vaginal wall in such a manner as to leave an opening only large enough to admit the introduction of a No. 10 soft rubber catheter. Anterior to the vesicovaginal opening the vaginal flaps were brought together in the median line by chromic acid catgut suture, leaving a space under the pubic arch for drainage of the rather large retropubic cavity. A soft rubber catheter was fixed in the bladder by suture to the vagina for continuous drainage. The inguinal glands of both sides were likewise excised.

After three days the catheter was removed and to my surprise the patient had fairly good control of her urine, which was continuous until she got up on the ninth day. Since then the condition is this—she can hold her urine while in bed and has fair control when up, that is, there is no continuous incontinence, but when the desire to pass urine comes on she must void it at once.

I have been prompted to report this case because of the difficulty I experienced, in looking up the literature of the subject, in finding any detailed description of the surgical manner of dealing with this condition. The technique practiced was evolved by myself and is seemingly correct in principle.

A SIMPLE HEAT METHOD OF STERILIZING AND STORING CATGUT

After Ten Years' Use of It

By WILLARD BARTLETT, A. M., M. D., Saint Louis

AFTER years of experimentation with absorbable materials, the author began, early in 1904, to employ regularly the method of preparing catgut which was embodied in a preliminary report published in the *Interstate Medical Journal* of March, 1905. The Mayo Clinic was the first of the many large institutions to adopt and use it as a routine procedure. During the nine years which have just passed, gut prepared in this way has been used at Rochester with satisfaction in more than sixty-three thousand operations. This is perhaps the most eloquent testimonial that could be accorded the practical worth of a hospital method and makes it unnecessary to detail the many and crucial bacteriologic checks which have been employed.

The real object of this writing is not only to set forth the small refinements which have crept into the method during the ten years of its employment by me, but at the same time to render impossible in other hands the occasional errors in technique which have resulted from lack of detail in my early published directions. Frequent requests for information make my duty in this direction obvious.

The process is to be divided into these definite steps: *drying*, *sterilization* and *storage*.

1. The ordinary commercial ten-foot catgut strand is divided into four equal lengths, each of which is made into a coil about the diameter of a silver quarter. By twisting the last free end three or four times around the components of this little coil the latter is enabled to maintain its shape. These coils are then strung like beads upon a thread so that any desired number can be conveniently handled by simply grasping the thread.

2. The string of catgut coils is dried in a bacteriologist's dry sterilizer for four successive hours at a temperature of 80 degrees, 90 degrees, 100 degrees, and 110 degrees centigrade. Let thin gauze be interposed between catgut and metal. This should not be attempted on a *damp day* or in a *room which steam enters*.

3. The catgut is immediately placed in liquid albolene (petrolatum liquidium) where it is allowed to remain until perfectly "clear" in the sense that the term is used in the preparation of histological specimens. This is usually accomplished in a few hours, though it has been my custom to allow the gut to remain in the oil over night. Thin paper must line the receptacle so that the catgut may not touch its walls.

4. The vessel containing the oil is placed upon a pan of sand and the temperature raised by a gas-flame during one hour to 160 degrees centigrade, which temperature is maintained for a second hour.

5. By seizing the thread with a sterile forceps the gut is lifted out of the oil, an excess of which is allowed to drip off, the thread is cut and the coils dropped into a solution of iodine crystals in Columbian spirits (deodorized methyl alcohol), the proportion of iodine varying according to the diameter of the catgut. For No. 00 it should be 1 to 700; for No. 0, 1 to 600; for No. 1, 1 to 500; for No. 2, 1 to 400; for No. 3, 1 to 300; for No. 4, 1 to 200; the iodine being taken by weight and the alcohol by volume. The material becomes

ready for use in a few hours, and should remain in the solution indefinitely without deterioration. A few coils may be removed at any time with no risk of contaminating those left behind.

Although I should be far from adopting a surgical procedure simply because it is economical, it will strike anyone that the chemicals here used are very cheap. Furthermore, the liquid albolene can be used repeatedly in spite of its color growing darker with reheating.

It seems to me important that the gut should be thoroughly "cleared" before the oil is heated, in order that we may thus be certain that the temperature at the center of the strand becomes as high as that of the oil surrounding it.

It may be noted that I do not remove the oil from the gut before placing it in the storing solution. This is avoided purposely, since catgut which is perfectly free from oil is so very sensitive to the action of water that it readily untwists and becomes tangled after it has been used in a wound but a few moments. This storing fluid simply takes off enough oil from the exterior of the strand so that it is not too slippery for use, and the albolene, being a bland, non-irritating substance, can safely be introduced into the tissues.

The iodine rapidly permeates the strand, which will be found stained brown after a few hours, assuring the surgeon that he is introducing an antiseptic as well as a thoroughly sterile suture material and one which is readily seen in the field of operation.

As far as the tensile strength, the elasticity, and the pliability of this finished product are concerned, I may state that these leave nothing to be desired.

I have made a large number of breaking tests, and have found no other heat method to produce a stronger strand.

Catgut treated in this way lasts in the tissues somewhat longer than the same size strand of *plain* gut treated by most of the other methods in vogue at the present time.

I have found that the material so treated deteriorates not at all with age, neither as far as strength nor sterility is concerned.

The physical qualities of the finished strand will astonish the surgeon who uses it for the first time. I am very certain that a blind man used to handling catgut prepared by other methods would not recognize this product as catgut at all if it were placed in his sensitive hands.

A NEW OPERATIVE PROCEDURE FOR THE TREATMENT OF SUPPURATIVE SALPINGITIS IN YOUNG WOMEN

By W. BLAIR BELL, B. S., M. D., Liverpool, England

FOR the treatment of bilateral pyosalpinges in young women one of the following operative procedures is usually adopted:

1. Bilateral salpingectomy by ligature.
2. Bilateral salpingectomy, with excision of the uterine ends of the tubes.
3. Bilateral salpingectomy, by one of the above methods, with unilateral or bilateral oöphorectomy.
4. Bilateral salpingectomy, by one of the above methods, and hysterectomy (subtotal or total) with or without unilateral or bilateral oöphorectomy.

I have myself always held the opinion, which is based on experimental[1] and clinical observation,[2] that complete bilateral öophorectomy in young women is an unscientific and unjustifiable procedure in the absence of malignant disease, of bilateral innocent tumors, or of bilateral ovarian abscesses.

It is, however, impossible here to enter into a discussion of this subject. It is one about which diametrically opposed views are held. The reasons for my own are set out in the communications referred to[1,2]. Let me state, therefore, at the commencement that the justification for and desirability of the procedure I have devised, and shall describe presently, depend to a large extent on the belief that the internal secretions of the gonads and the existence of the menstrual function are of considerable benefit, both physical and psychical, to the young adult female.

That is the first important point, and it is a physiological one.

Next, with regard to the pathological aspect of the procedure, it is well known that with ascending tubal infections the fundus of the

[1] Bell, W. Blair: "The genital functions of the ductless glands," Arris & Gale Lectures, Roy. Coll. Surg. Eng., Lancet, 1913, March 22 and April 5.

[2] Idem, Introduction to a discussion on "The relation of the internal secretions to the female characteristics and functions in health and disease." Proc. Roy. Soc. Med., 1913, vii.

uterus, as well as the cervix in gonorrhœal conditions, is involved (Fig. 1). As a clinical result of infection of the body of the uterus we frequently see very severe menorrhagia and sometimes leucorrhœa persist after bilateral salpingectomy. Consequently it is advisable to adopt some procedure which will take into account the infection of the body of the uterus. Hence the pathological indications are no less important than the physiological.

My method of procedure meets both the physiological and pathological requirements described above.

It aims at removing diseased structures as widely as possible, while one ovary, or a portion of it, is preserved, together with sufficient endometrium to ensure the subsequent occurrence of regular menstruation.

In other words, both tubes, one ovary, and a wedge-shaped portion of the fundus uteri are removed.

The following are the steps of the operation:

1. The abdomen is opened in the usual way by a median subumbilical incision.

2. All superficial adhesions of omentum or bowel are put upon the stretch, ligated when necessary and cut through.

3. The intestines are then carefully packed off with the thin rubber pack which I have used for some years. Gauze can subsequently be introduced against the rubber pack if necessary.

4. The tubes and uterus are next completely freed, and pus in the pelvis is carefully mopped up as it is seen.

5. The patient is now lowered into the Trendelenburg position.

6. The uterus is raised by means of a volsellum attached to the fundus, and the operator proceeds to remove the tubes, undus uteri and one ovary in the following manner. (The steps are described for the operator, who stands, as the writer does, on the *left* side of the patient, placed in the Trendelenburg position.)

(*a*) The free edge of the mesosalpinx on the right side is seized with a pair of long compression forceps. The edge of the mesosalpinx is divided between the attachment of the forceps and the tube, which is held with another pair of compression forceps, and the mesosalpinx is cut through up to the uterine attachment of the tube. One or two bleeding vessels require to be caught in compression forceps and ligated. Likewise the free edge of the mesosalpinx is tied and the forceps are removed.

(*b*) The ovary and tube on the left side are next freed in a similar manner, except for the modifications needed by the removal of the ovary. The infundibulopelvic ligament is caught in two pairs of compression forceps and divided between them. The broad ligament just below the junction of the mesosalpinx and meso-ovarium is now cut through with scissors up to the uterus, and the bleeding vessels are caught as they are divided. If the curve of the junction of meso-ovarium and mesosalpinx be followed the section of the broad ligament will end just below the insertion of the tube and the attachment of the ovarian ligament. The severed vessels are tied.

Fig. 1. Infection of the fundus uteri. From a case of suppurative salpingitis.

Note the round-cell invasion of the musculature, proceeding from a small thin walled vessel on the left of the section x 200.

(*c*) A superficial incision is made from about half an inch below the insertion of the right tube across the front of the fundus of the uterus through the round ligaments, which are caught in compression forceps and tied, to a similar point on the opposite side. Another incision is then made between the same two points across the fundus posteriorly. The portion of fundus uteri thus marked out is removed by deepening the incisions downwards and inwards so that a wedge-shaped excision of the fundus is carried out (Fig. 2). The ascending uterine arteries on each side will be cut through in the final separation of the portion excised. They should be caught as they are cut, and ligated after the fundus has been removed.

(*d*) The large deep wedge-shaped wound in

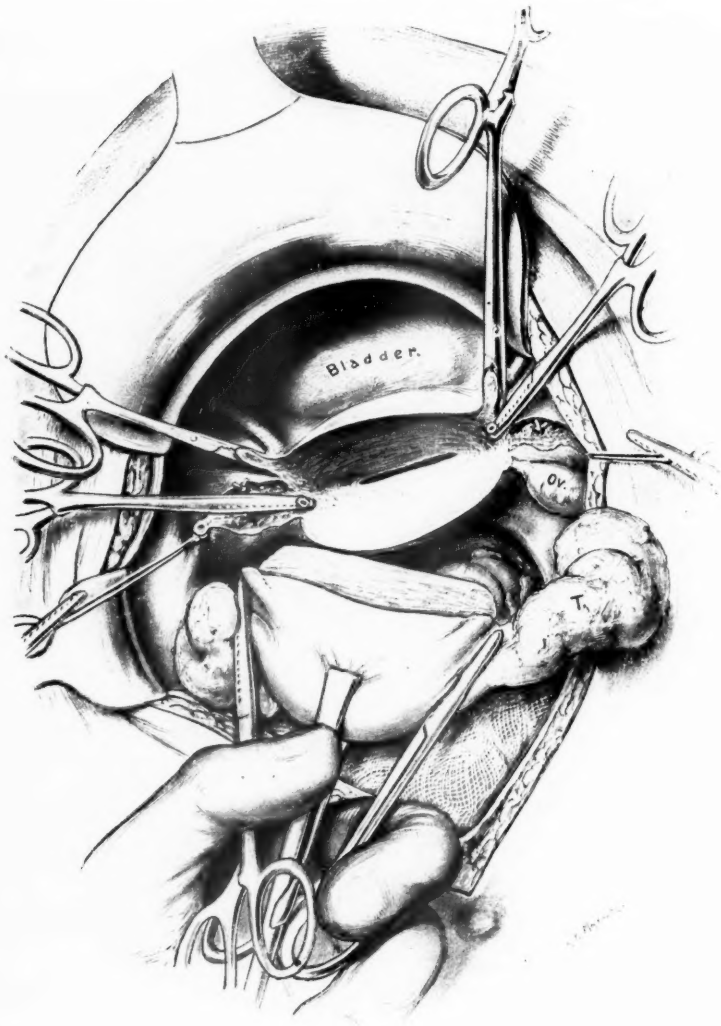


Fig. 2. Illustration of operation. The operation at the stage when the diseased parts have just been completely excised and are ready for removal. They are left *in situ* to show the relation of the parts removed to the remaining structures. (From Burghard's System of Operative Surgery.)

the uterus is partially closed by the insertion of four deeply placed mattress sutures which pass through both flaps.

(*e*) The edges of the right mesosalpinx are sewn together with a running suture, and all ligated points are covered with peritoneum. The running suture is continued over the summit of the stump of the uterus, in order to coapt with peritoneal surfaces of the flaps. The suture is then carried on to close the two peritoneal surfaces of the divided broad ligament on the left side. Care is taken to bury the ligated stump of the infundibulopelvic ligament between the two layers of peritoneum.

(*f*) The cut ends of the round ligaments are now sewn to the uterine stump on each side.

(*g*) The right ovarian ligament is also sewn to the right side of the uterine stump, and, if necessary, the free edge of the meso-ovarium is attached to the round ligament of the same side to prevent prolapse of the ovary.

7. Finally the abdominal incision is closed in the manner adopted by the individual operator.

In my hands the operation has proved most satisfactory. All symptoms have been removed and the patients have in all cases — except the last one operated upon quite recently — menstruated regularly and painlessly and to a moderate extent.

Since I devised this operation some eighteen months ago I have not had a sufficient number of cases nor are the after-histories long enough to report on at present, but this essential information will be given in due course.

Before closing this paper it is necessary that I should call attention to a brief statement in the Lancet,[1] which reported the International Congress last August, to the effect that Professor Beuttner of Geneva had made a communication concerning an operation which, so far as I can I gather from the brief statement made, corresponds with mine. I was not in London when the communication was made nor have I yet had an opportunity of reading an account of Professor Beuttner's technique. Before any mention of his procedure had been made I had contributed an account of my operation to the forthcoming edition of Burghard's Operative Surgery. Naturally, too, I had been performing the operation long before I wrote any account of it.

[1] Lancet, Lond., 1913, August 16, p. 483, and August 23, p. 597.

A PRELIMINARY REPORT ON THE TREATMENT OF FRACTURES BY FIXATION WITH ANIMAL BONE PLATES AND BONE SCREWS[2]

By E. J. BROUGHAM, M. D., and A. C. ECKE, M. D., Chicago

FIXATION devices consisting of bone, human or animal, and ivory, are not new: their technique simply varies. All the methods have their origin in the effort to procure the use of probable absorbable material, and so dispense with the metallic fixation material, which frequently causes a good deal of trouble.

The ideal fixation for fractures is undoubtedly the intramedullary autograft, but the technique is not so simple, and the procedure requires really two operations.

Magnuson's ivory plates countersunk into the fractured bones and transfixed with ivory screws is an admirable attempt to use absorbable material, but again, his technique is not simple.

Our procedure gives efficient fixation and the technique is as mechanically simple as that of the Lane plate, and requires no complicated tools. The material is bone from government inspected cattle. The bone comes to the market bleached, deprived of its animal matter, and in dry form.

The working set of bone plates (Fig. 1) is five in number, Plate No. 1 being the smallest and Plate No. 5 being the largest. They are all of equal thickness, about one-eighth of an inch, and according to standard gauge No. 9. The plates differ in their length and width, and the number of threaded holes in each plate. They are concave on the under surface. The tops are plain, with slightly rounded ends and edges.

The complete set is received by the surgeon already drilled and threaded. They are thoroughly scrubbed with hot water, soap and brush, rinsed and sterilized by boiling for two hours and placed in formalized alcohol; shortly before using they are put in normal salt solution. Neither the boiling nor the antiseptics injure the plate or the trueness of the threads.

The size of the threads are twenty to the inch, and are fashioned with a 12x20 standard steel tap, which signifies twelve gauge drill with which the holes are drilled, and corresponding to the thread turned upon the bone screws. The purpose of the greater number of holes in the larger plates is to accommodate, if occasion requires. Plates may be sawed off and made shorter. The remaining holes not needed serve as drainage. The entire set of five plates with screws are sterilized and made ready for the operation. The surgeon selects from the lot the plate best suited to the fracture he desires to fix.

After bringing the ends in apposition and holding the same firmly in place with a pair of forceps he places the plate in the wound over the fracture.

[2] Read before Chicago Surgical Society, March 6, 1914.

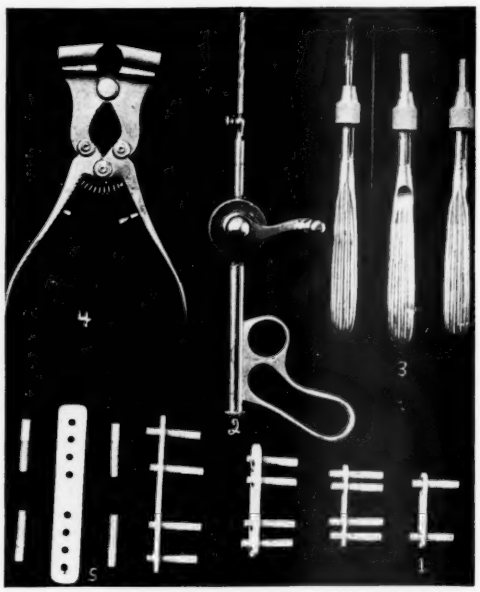


Fig. 1.

The plate is held from slipping by an assistant, with long tissue forceps pressing upon it. Next, a Richter brace (2) previously mounted with the twelve-gauge spiral drill, is used to drill the fractured bone at each end, care being taken not to go deeper than is needed—just through the cortex, and not the medulla. Next, the steel tap previously mounted in a long-handled chuck (3) is carefully turned through the already made thread in the plate, and on into the bone, turning it backward to ease it and prevent binding, and turning it ahead to fashion the thread in the underlying fractured bone. Next, the long-handled holding chuck, with the bone screw previously mounted, is taken up and the screw is turned carefully and securely through the plate, and through the cortex of the underlying fractured bone; after testing its firmness by a gentle upward traction on the chuck, the screw is in place; with a pair of forceps, loosen the grasp of the chuck on the bone screw and remove the holding chuck, leaving the bone screw with the part held by the chuck projecting upwards.

The empty holding chuck is then refilled by assistant. We have two holding chucks to facilitate the placing of screws. Next, the bone is again drilled through the hole at the other extremity of the plate, the tap introduced, the bone screw placed in the same manner, and the plate thus secured. Next, the intermediate holes are drilled and the bone screws placed. Usually four are put in. The projecting bone screws above the bone plate may be clipped off after each bone screw is placed, and before proceeding with another; or they may all be placed, and then sawed off with a small metacarpal saw. In using our special bone clipper (4) for clipping off the projecting bone screws, each screw must be clipped off when it is placed to make room to adapt the clipper accurately to the screw to be clipped off. This instrument is a compound lever clipper, and very powerful, and if not held free and in accurate position may damage the bone screw.

The entire operation is conducted according to the technique of Lane of London. Towels are clamped to the edges of the wound. All the suture material, needles, gauze, sponges, plates, screws, drills, and everything used to carry on the operation must be handled with steel instruments.

After wound is sutured, dressings and cast are applied. When one or more plates have been used from the set they may be ordered singly, and the working set thereby kept complete. The stock material from which the bone pates are made are of sufficient bulk to permit much heavier and much larger plates and screws if it were desired, but keeping in mind the absorption of the plates we made these as light as consistent with strength.

The other instruments used are the usual bone plating instruments familiar to surgeons. We recommend and have used satisfactorily Lane forceps, Lane elevator skid, and Richter brace. The bone plates have been used in the following three cases.

Case 1. W. P. R., male, aged 51 years; working in a meat market, August 2, 1913. While attempting to lift and turn around a quarter of beef same slipped from his grasp and slid on to his left thigh. With renewed effort and exertion of muscles and thigh he succeeded in placing it back upon the hook. Patient began to suffer pains in the upper thigh but kept at work and hobbled about with aid of a cane for a period of three weeks, when his left side suddenly weakened and let him down on the ground. He was unable to walk, and was conveyed to his home. Three days later he was admitted to the Passavant Hospital. Examination showed marked swelling of the left upper thigh anteriorly and laterally. X-ray showed an oblique subtrochanteric fracture. The fracture was treated for eight weeks by extension, counterextension and a long side splint. At the end of this time there seemed to be no callus, thigh angling, and shortening of an inch and a half when relieved of extension weights. We decided to plate the femur. At operation no callus was found. The ends of the fractured bones were cleansed and thoroughly curetted; the fracture reduced and a bone plate three inches long with four screw holes applied. There was a

Case 2. Male, age 23, showing bone plate and fracture eight weeks after plating. Patient about in ten weeks.

Case 3. Male, age 8 years. Bone plate in position day after operation.

good deal of difficulty to get room for upper end of plate because of trochanter, and only one screw could be placed here. The bone was very soft. Wound closed with silkworm sutures, dressing and plaster cast applied. Patient returned to bed. No extension. Cast remained for four and a half weeks; being soiled and softened was removed. Dressing showed a moderate amount of oozing; sutures were taken out, dressing applied. Examination showed no angling or shortening. Another cast was put on and left four weeks. At its removal the limb was X-rayed, showing plate in good position. Palpation showed a large amount of callus. Patient was able to elevate thigh, abduct and adduct same. Callus was not sufficiently ossified at the time, and the patient attempted to bear his weight on the limb causing callus to yield. X-ray showed lower end of plate slightly lifted, allowing slight angling. Thereupon cast was reapplied and remained six weeks. Ten days after its removal, patient was allowed to be about with aid of crutches.

We are satisfied the plate held and served its purpose sufficiently long for a normal fracture to unite, and it even stimulated callus formation in our opinion.

Case 2. Y. M., male, aged 23 years; laborer for construction company. He was injured by a roof collapsing and falling upon him while wrecking a building; was standing on an elevation about five feet from the ground; was thrown and pinned under fallen roof. He was admitted to Passavant Hospital the day of his accident, December 3, 1913.

Examina ion showed five fractures of the left leg, two of the femur, one of the tibia, and two of the fibula. The fracture of tibia was compound, of oblique type, upper fragment projecting through wound and foot dangling. This fracture was plated immediately with the bone plate and four screws. The plate contained six holes, the two unused holes serving for drainage. The wound was closed with a small strip of gauze for drainage; dressing and cast applied up to knee, and leg put on double incline plane for the femur fractures.

Cast was fenestrated ten days later, drain and stitches removed, and wound comparatively dry. Cast was removed after three weeks. Second cast applied and left for five weeks; after its removal patient remained on incline plane for a week longer. He was then allowed to be up and about with crutches. A week later was walking with aid of cane. X-ray (Fig. 2) showed plate in position and tibia in good line, also loose piece of fibula well mortised.

Case 3. Wm. B., male, aged 8 years; was admitted to Passavant Hospital January 30, 1914, to the service of Dr. M. L. Harris. He had been injured by being knocked down by a passing automobile. Examination showed fracture about middle of left femur. Repeated attempts at closed reduction not being satisfactory, February 13th.

two weeks after his admission, case was plated by Dr. Harris with the bone plate and four bone screws. Operation disclosed separation of fractured end with muscle tissue interposed. Fracture was of the transverse type, with a V-shaped portion of lower fragment about three-eighths of an inch in widest measurement wanting. Harris wire suture used for closing wound, and cast applied. Patient put to bed, no extension. X-ray following day showed plate in position and perfect apposition of fractured ends. Cast fenestrated February 24th, wound dry, wire suture removed, reinforced cast without removal. X-ray at this time, twelve days after plating, perfect; apposition of fracture and bone plate in posi ion.

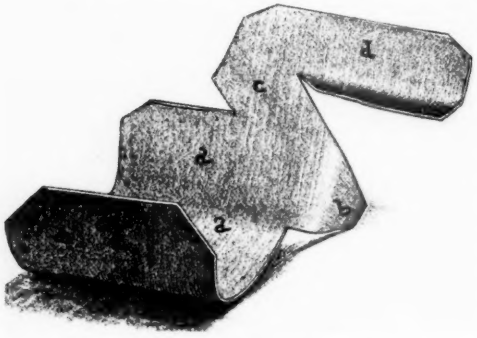
The cast was removed five and a half weeks from date of operation. Patient returned to bed, no cast applied. Examination shows solid union, large callus, no shortening; perfect results. Final X-ray (Fig. 3) showed bone plate in position, perfect alignment of fracture.

THE TREATMENT OF A CASE OF BIRTH FRACTURE OF THE SHAFT OF THE FEMUR

By VILRAY P. BLAIR, A. M., M. D., F. A. C. S., Saint Louis, Missouri

IN the case of a large infant in a breech presentation the shaft of the left femur had suffered a transverse fracture; considerable angling resulting. This was to me a new condition and its treatment presented several special problems.

First, the very meager circulation of the lower limb must not be impeded by tight bandages, nor do I believe the skin would tolerate adhesive plaster. Second, the ordinary care of a newborn infant, bathing, nursing, etc., must not be



interfered with. Last, the injured bone should be maintained in its proper outline while healing occurs. These indications were met by the splint shown in the illustration.

A pasteboard pattern was first made, and from it a splint of galvanized steel was cut. The steel was of the weight used for house gutters and down spouts. The body portion (*a*) reached from the greater trochanter of the femur to the axilla, and enveloped the back and both sides fairly closely. The small buttress (*b*) maintained the stability of the body portion by resting squarely on the bed or table. The thigh portion (*c*) corresponded with the normal position of a baby's thigh when it is crying and thereby straining. The leg part of the splint (*d*) was longer than the infant's leg and its lower border was bent mesially to form a small shelf.

This splint was heavily padded. The baby was laid in the body position, resting there simply by its weight; while the thigh and leg, after being covered with cotton, were bandaged to the splint. The napkin was not placed on the child in the ordinary manner, but was folded in several thicknesses, and simply laid under the buttocks, the upper border of this pad extending up between the splint and the nates.

This splint was entirely removed and reapplied every day at the time the child was bathed and powdered, the injured limb being held in the proper position by the aid of a second person. After the first few days the application of the splint was done entirely by the nurse. The baby nursed and apparently suffered no discomfort from the splint.

In the first attempt at making the splint, the part for the lower limb was made vertical and the leg and thigh bandaged loosely to it. This proved ineffective and also the very loose bandaging over cotton seriously impeded the circulation. The splint was then bent to a right angle at the knee. This was an improvement, but there was a forward angling of the shaft when the child cried, so a new splint cut on the lines shown seemed to overcome these difficulties.

There was firm union in excellent position in four weeks.

PERSONAL EXPERIENCES WITH COAGULÈNE-KOCHER-FONIO

A Critique of Twenty Cases in which the Preparation was Used

By GEORGE DE TARNOWSKY, M. D., Chicago
Attending Surgeon, Cook County and Ravenswood Hospitals

WHILE on a recent visit to Kocher's clinic in Berne, my attention was called to a new method of checking hæmorrhage in the course of surgical operations. Doctor Anton Fonio, first assistant to Professor Kocher, who elaborated the preparation, published his first report of seventy-five cases (December, 1912, to March, 1913) in the Correspondenz-Blatt für schweizer Aerzte (1), and I have made free use of his article in the preparation of this report. Dr. Fonio began his study of the subject in 1909 (2), Professor Kocher having requested him to evolve a practical thrombin for clinical purposes. Kocher himself had for several years successfully made use of pieces of fresh muscle-tissue applied to oozing surfaces in brain operations. The monographs of Bordet (3), Nolf (4), Sahli (5), Lilienfeld (6), Fuld (7), Zak (8), and of Bordet and Delange (9 and 10), should be freely consulted in order to obtain a detailed account of the various theories of blood coagulation.

In view of the many conflicting opinions expressed, it seems probable that in the process of blood-coagulation two or three "mother-substances" contribute, either equally or in a varying degree, to the reaction, thus allowing the active coagulation agent to develop. The presence of calcium salts is necessary for the complete reaction. The following tabulated grouping of the newest theories of coagulation is taken from Fonio's original article:

A. Schmidt: Prothrombin+zymoplastic substance=thrombin (fibrin-ferment)
Lilienfeld: Leuconuclein+fibrinogen=thrombosin+calcium=fibrin+fibrin-ferment (soluble globulin)
Arthus and Paget: Fibrin-ferment+calcium+fibrinogen=fibrin+globulin (soluble)
Morawitz: Thrombokinase+thrombogen=a prothrombin+(b prothrombin)+calcium=thrombin (fibrin-ferment)
Fuld: Cytozym+plasmozym+calcium=holozym (active ferment)
Nolf: Thrombozym+thrombogen+fibrinogen+calcium=fibrin+thrombin (soluble)
Bordet and Delange: Cytozym+serozym+calcium=thrombin (active agent)=fibrin.

With these several theories as a working basis, Fonio sought to isolate one of the active coagulating elements of the blood in such a manner and quantity as to make its everyday usage practicable. It had been known for some time that Bizzozero's blood-platelets were of a lighter specific gravity than either the erythrocytes or leucocytes, but Morawitz (10) was the first to isolate them through fractional centrifugation. Bordet and others had also shown that the blood-platelets could stand a temperature of 100° C. for several minutes without losing their activity. Their rôle in blood coagulation was also well known. Bürker (11) and others were able to arrest coagulation by preventing the disintegration of the platelets; it is, therefore, believed that, in this process of disintegration, a substance is liberated which brings about the ferment-like elaboration of fibrin. Fonio is of the opinion that the platelets constitute the only element in the blood which furnishes thrombozym, but this belief is not universally accepted. In order to obtain blood-platelets, many technical difficulties had to be surmounted. The process of separating these elements can never be an easy one as their chief characteristics are their viscosity and vulnerability. Through fractional centrifugation of mammalian blood Fonio succeeded in obtaining platelets free from all other blood elements.

The details of this process have not yet been published. A cell-free preparation of thrombozym was obtained by extraction which was sterilized by heating to 100° C. for fifteen minutes and then placed in ampoules ready for use. To this preparation, which intensifies and accelerates coagulation both *in vitro* and in the living, the name of Coagulène-Kocher-Fonio was given. It retains its activity after heating to 98° C. for fifteen minutes, and is soluble in alcohol, chloroform, water, normal salt solution, etc. As prepared at present for commercial purposes (through the courtesy of Dr. Fonio I was able to obtain fifty grams of the powdered preparation from the "Gesellschaft für Chemische Industrie" in Basel, Switzerland), it comes in the form of a granular substance having a sugar basis, and is simply dissolved in sterile water and boiled for five minutes. The strength of this solution, as recommended by Fonio, is either five or ten per cent. Once dissolved, the preparation must be used within twenty-four hours as it rapidly loses its activity.

In a large series of tests *in vitro*, Fonio con-

clusively proved that animal coagulène hastens the process of coagulation at all stages, and that, once coagulation begins, it rapidly becomes complete. He found on the contrary that human coagulène only hastened the end-process of coagulation, it having no effect on the initial stage. The effect of coagulène on fresh wound surfaces was found to be more rapid than *in vitro*.

Technique. One gram of coagulène is dissolved in 20 ccm. of sterile water and boiled for five minutes. The solution can be sterilized in the autoclave, but it has seemed simpler to me to place the liquid in a glass container (an ordinary Mason jar answers the purpose very well) which is partially immersed in boiling water. Both the solution and the jar must of course be warm before plunging the latter in boiling water. It will be noticed that the fluid is slightly turbid, containing small undissolved particles. It is not necessary, however, to filter, even for intravenous injection. Aspirate the coagulène in a syringe and place it on the instrument tray, ready for use. Having made the skin incision, clamp or compress the larger blood-vessels momentarily, then apply a few drops of coagulène and wait until coagulation has occurred before proceeding. Experience has shown that the thrombus in the larger blood-vessels may not hold; therefore, it is preferable to ligate them immediately. The incision is then continued through the deeper tissues, coagulène being instilled whenever needed. Two very important postulates must be remembered: the first is that coagulène must be applied at the very site of the bleeding, on the oozing surfaces of the wound; the second is that the coagulum, once formed, must not be wiped off, by sponges or otherwise, because in so doing the small thrombi are pulled out of the vessels and the bleeding reappears.

The only action of coagulène is to accelerate and intensify the normal process of thrombus formation. Crushing of the larger arteries by means of hæmostats assists in the thrombus formation; adrenalin may also be used to reinforce the action of coagulène by its vasoconstrictor effect. In laparotomies, the most important field of usefulness has seemed to be in those cases requiring the freeing of adhesions, old or recent. In this type of case, coagulène is an ideal substitute for the hot laparotomy pad or tamponade. A few drops of the solution applied directly to the oozing surface will enable the surgeon to continue his work unhampered by gauze pads or repeated and annoying sponging by his assistants. In the closing of laparotomy or herniotomy wounds, coagulène prevents the formation of that "*bête noire*" of the surgeon — the subcutaneous or subfascial hæmatoma.

In bone operations the use of coagulène is especially valuable inasmuch as it checks the constant oozing of bone and surrounding tissue, thereby avoiding the necessity of repeated sponging. In a recent personal communication from Dr. Fonio (January, 1914) he states that coagulène has given the best results in bone operations, strumectomies and craniotomies. The Kocher clinic is also, at present writing, using coagulène in skin-grafting, in hæmophilia, hæmoptysis and gastroduodenal hæmorrhages. A monograph on its intravenous use is shortly to appear from the same source.

That wounds will heal more rapidly and with a minimum of connective-tissue cells between the cut surfaces, in the absence of capillary oozing, is self-evident. Fonio believes that wounds on which coagulène has been applied heal more rapidly than those not so treated. I am not, as yet, prepared to comfirm this statement which, *a priori*, seems logical. It is certain that the accurate coaptation of homogeneous tissues and the elimination of blood-clots which would tend to separate these tissues is a surgical desideratum.

In rhinological and laryngological operations coagulène is used in the form of a ten per cent spray, or sponges, soaked in the same strength solution, are applied directly to the bleeding surfaces. H. Obermüller (13) found the solution very excellent in checking secondary hæmorrhages following turbinectomies or septum resections. After the application of ten per cent coagulène he was able, with perfect safety, to send his patients home without applying nasal tampons. Used in spray form after adenectomies and tonsillectomies, it brought about efficient and prompt coagulation. Owing to the pleasant sweet taste of the solution, Obermüller used it as a post-operative gargle for children. Equally favorable results were obtained in the radical operations for antrum of Highmore disease; for ethmoiditis; in the excision of papillomata of the larynx or extirpation of the epiglottis. In all of these types of operation the field of operation is kept free from capillary oozing, and tamponade, where previously indicated, becomes unnecessary.

PERSONAL EXPERIENCES

Case 1. Exploratory laparotomy, September 23, 1913, Cook County Hospital. Coagulène used in abdominal incision. Capillary oozing ceased within a few seconds. Healing per primam.

Case 2. Cholecystostomy, September 25, 1913, Cook County Hospital. Gall-bladder freed from old adhesions;

capillary oozing rapidly checked by means of coagulène. Primary union.

CASE 3. Congenital multilocular cyst of right kidney, September 25, 1913, Cook County Hospital. In this case coagulène was remarkably useful. After opening the entire kidney from pole to pole and evacuating the cysts, 10 ccm. of a 5 per cent solution of coagulène were poured in the cavity. A large coagulum formed within a minute, effectively checking all hæmorrhage. One rubber drain was left in the kidney substance for twenty-four hours. Patient made an uneventful recovery.

CASE 4. Angioma cavernosum of the right iliac fossa, September 27, 1913, Cook County Hospital. An exploratory laparotomy was performed, but, in view of the size and extent of the angioma, excision was not attempted. Coagulène was freely used throughout the operation and controlled hæmorrhage with perfect satisfaction.

CASE 5. Ravenswood Hospital, October 2, 1913. Retroversio uteri, ovarian cysts; chronic appendicitis. In this case numerous adhesions were loosened, coagulène controlling the capillary oozing with marked rapidity. Normal recovery per primam.

CASE 6. Ravenswood Hospital, October 8, 1913. Traumatic bi-inguinal herniæ. Following the experience of the Kocher clinic, I ligated the superficial epigastric arteries and veins, coagulène checking the bleeding from smaller vessels. Normal recovery; primary union.

CASE 7. Ravenswood Hospital, October 11, 1913. Encysted lipoma of right mamma. Excision; coagulène thrombus-formation, closure without drainage. Normal recovery.

CASE 8. Cook County Hospital, October 14, 1913. Nephrectomy, three weeks after exploratory nephrotomy for traumatic rupture. Hæmorrhage from adhesions was very profuse and annoying, but readily controlled by coagulène. General peritonitis was, however, already present, and patient succumbed to the infection and cachexia seven days later.

CASE 9. Angioma cavernosum of face, October 14, 1913, Cook County Hospital. This tumor, the size of an English walnut, was situated on the right cheek, opposite the external auditory meatus. It was extremely vascular and had recently become infected. Instead of applying the coagulène on the incision, I experimentally plunged the syringe needle under the base of the angioma and injected a few drops of the solution at various points in its periphery. The ease with which the tumor was excised and the almost total absence of hæmorrhage which was encountered during the succeeding steps of the operation were quite convincing of the efficacy of this method. Normal recovery.

CASE 10. Carcinoma of colon, October 16, 1913, Cook County Hospital. The ascending and transverse colon and six feet of ileum formed an inseparable mass. Adhesions were at first freed, but as the ileum was found to be the seat of metastatic growths, the entire mass was removed, the descending colon closed at the sigmoid flexure, and the normal free end of the remaining ileum implanted in the sigmoid. Throughout the steps of this tedious operation, coagulène was a valuable aid in checking hæmorrhage. The patient died of shock sixteen hours later.

CASE 11. October 23, 1913, Cook County Hospital. Fracture of olecranon process of left ulna, open repair. Coagulène applied to oozing bone and fascial surfaces. Incision closed without drainage. Normal recovery without post-operative hæmatoma.

CASE 12. October 31, 1913, Cook County Hospital. Ventral hernia. Repair by vertical imbrication. Coagulène was used throughout the operation with perfect satisfaction. Normal recovery.

CASE 13. October 31, 1913, Cook County Hospital. Double fracture of left humerus with irreducible forward displacement of distal end of lower fracture. Lane plating of lower fragments. Coagulène was freely used on the oozing bone surfaces with very marked satisfaction. Incision closed without drainage. Healing per primam. Three and a half weeks later musculospiral paralysis appeared, due to compression of the nerve in the callus of the upper fracture.

CASE 14. November 4, 1913, Cook County Hospital. Amputation of right leg. Coagulène gave ample satisfaction, checking both bone and muscle oozing. Normal recovery.

CASE 15. November 11, 1913, Cook County Hospital. Right inguinal herniotomy. Superficial epigastric artery and vein ligated; all other bleeding surfaces controlled by coagulène. Normal recovery. Healing per primam.

CASE 16. November 11, 1913, Cook County Hospital. Stricture of rectum; colored female, 39 years old. Excision through a posterior vaginal incision with anastomosis of bowel ends. Coagulène freely used to control the profuse venous hæmorrhage encountered, thereby greatly facilitating the operation. Secondary infection with retrovaginal fistula occurred. Patient was operated upon a second time by a colleague, but eventually died of sepsis.

CASE 17. January 14, 1914. Cook County Hospital. Right oblique inguinal hernia; previously "cured" by the injection of paraffin, the removal of which, with its surrounding adhesions, provoked considerable hæmorrhage. Coagulène was promptly efficacious. Normal recovery. Healing per primam.

CASE 18. January 14, 1914, Cook County Hospital. Left oblique inguinal hernia. Coagulène relied upon to check all bleeding with the exception of the superficial epigastric vessels, which were ligated. Normal recovery. Healing per primam.

CASE 19. January 14, 1914, Cook County Hospital. Retrodislocation of right clavicle. After several attempts at reduction had failed, the acromioclavicular ligaments were reached by a semilunar incision, the clavicle replaced and ligaments sutured. Coagulène freely used to check hæmorrhage. Closure without drainage. Normal recovery. Healing per primam.

CASE 20. Miss T. C., age 10. Purpura hæmorrhagica Werlhofii. Through the courtesy of Dr. R. R. Ferguson of Chicago, I was allowed the privilege of using coagulène intravenously. Dr. Ferguson's notes are as follows: On December 12, 1913, patient returned home from school feeling tired and complaining of "weakness" and pain in the epigastrium. Temperature 97°, pulse 115, respiration 18. Treated symptomatically by some other physician for one week. December 19, 1913, hæmorrhagic spots appeared about the elbows and knees. The abdominal pains continued. Patient was restless and slept poorly. Hæmorrhage from the nose, bowels, and vagina. Œdema of lower extremities; blood and albumin in the urine. Abdominal pains appeared to cease after onset of melæna. Entered Ravenswood Hospital, January 15, 1914. *Examination:* Face bloodless and slightly œdematous; radial pulse "thready." Blood issuing from nose, vagina, and rectum. Temperature 90°, pulse 130, respiration 24. Patient feels very weak and exhausted.

With the assistance of Dr. Ferguson, the left internal saphenous vein was freed at the tip of Scarpa's triangle. The patient was so exsanguinated that compression of the upper extremities did not cause any visible filling of the median basilic or median cephalic veins; hence my selection of the internal saphenous vein. A five per cent solution of coagulène was freshly prepared, sterilized and cooled to body temperature. Ten ccm. of normal saline

were first injected, then 200 ccm. of five per cent coagulène, followed by approximately fifteen ccm. normal saline solution — 250 ccm. of fluid in all. It was noted at the time that the child could actually feel the warm solution flowing up the left iliac and inferior vena cava, as she called attention to the fact!

Twenty-four hours later the hospital record was as follows: Temperature 98°, pulse 94, respiration 18. Nasal and vaginal hæmorrhages have ceased. Some bloody mucus in stools which, however, are formed and yellowish in color.

This improvement continued for three or four days, when hæmoglobinuria became marked. As I had practically exhausted my available supply of coagulène, the injection could not be repeated. A desiccated horse serum was used but no improvement was noted. At present writing (February 14, 1914) general anasarca is present and hæmoglobinuria continues. The bloody stools have ceased. The child is now evidently losing ground.

This case is cited to show that, in order to permanently check hæmorrhages due to metabolic changes, repeated doses must be given. The immediate results obtained are encouraging and warrant further clinical studies along the same lines.

Numerous blood-coagulating substances have already been offered to the profession, principally, it is true, for the treatment of hæmophilia. Wooldrige (14) was the first to show that alcoholic extracts of any kind of protoplasm had coagulating power. Bernheim (15) demonstrated the blood-coagulating power of an extract of blood-vessel walls. Von der Velden (16) discovered that 5 to 15 gms. of sodium chloride *per os* increased the coagulating power of the patient's blood. Strontium lactate, calcium chloride, and gelatine have, in the past, had their advocates. Weil (17) was the first to inject fresh horse serum in the treatment of hæmophilia, and Sahli (18) in 1910 successfully used antitoxin of diphtheria for the same purpose. The advantages of Coagulène-Kocher-Fonio over any of the preceding methods which at once suggest themselves are:

1. In powder form it is a stable solution. (The exact length of time during which it retains its maximum activity has, of course, not yet been determined. I recently used the last gramme of coagulène in my possession on a tonsillectomy and found the solution normally active after five months. It is, therefore, certainly stable enough for practical purposes.)
2. It is readily prepared.
3. It is sterilizable without losing its activity.
4. It is available for local, subcutaneous, and intravenous use.
5. On both theoretical and clinical grounds it is the most powerful coagulant at our disposal.

An unbiased critique of my twenty cases, added to the seventy-five cases reported in the Kocher clinic, convince me that in coagulène we have a preparation the employment of which tends to shorten and simplify our operative technique. Fewer ligatures are needed and capillary oozing is reduced to a minimum; therefore it would seem that primary union ought to be more readily obtained. A vast field is open, and the theoretical possibilities of this preparation loom large. Clinical reports on its use in hæmophilia, pulmonary hæmorrhage, hæmorrhagic pancreatitis, bleeding gastric or duodenal ulcers, etc., are still lacking. My single experience with the intravenous injection of coagulène in purpura hæmorrhagia was encouraging, but the insufficient quantity of the substance at my disposal prevented me from repeating the dosage. The Kocher clinic has also begun using coagulène intravenously, but reports are not yet available.

The writer feels sufficiently encouraged to pursue further investigations as soon as a fresh supply of coagulène is available and is at present confident that a useful and serviceable adjunct has been added to our surgical technique.

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A BRIEF CONSIDERATION OF SOME RECENT TESTS FOR GASTRIC CARCINOMA

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THIS paper is simply a very brief consideration of a few of the more important tests for gastric carcinoma, and incidentally, for carcinoma in general, which I have selected from the large number of tests proposed, and with which recent literature is filled. I have nothing original to offer, and my only apology for approaching a subject on which so much has already been written is its importance, and the hope that a brief description of a few of these tests might prove of general interest.

Early diagnosis in cancer of the stomach is an absolute necessity if we are to be of any real assistance to the patient, and anything which can in the slightest degree contribute to this early diagnosis cannot be neglected. The duration of life in this condition is very short; after the disease is so far developed that the diagnosis is plain, the average duration of life is only one year. When this stage is reached, palliative treatment is alone possible.

The difficulty of this early diagnosis has led numbers of investigators, in the last few years, to seek new and improved methods by means of which the diagnosis can be made with certainty in the early stages. The solution of the question has been approached in many different ways — by some, through an investigation of the stomach-contents and urine; by others, through serological methods. The X-rays also play a significant rôle, and lately have done much to advance our knowledge of diseases of the stomach. Nevertheless, none of the many methods has realized the highest hope. Therefore, the fact remains that new investigations will always be undertaken, in order to gain a nearer approach to the difficult problem. Numerous demonstrations show, almost without exception, that none of the tests gives results which are pathognomonic for the disease in question, and their interpretation is, on that account, of not much greater value than any of the other clinical symptoms.

The test which above all others is probably the most widely known and used is the glycyltryptophan test of Neubauer and Fischer, and its modifications. As originally proposed, in 1909, the test was very simple, and could be used by any practitioner anywhere. It consisted in mixing glycyltryptophan, a polypeptid, with a portion of filtered gastric juice obtained after the usual test breakfast, incubating for twenty-four hours, and then testing with bromine vapor for the rose-violet color of free tryptophan. Their conclusions were as follows:

1. There exists in carcinomatous stomachs a ferment, which, contrary to pepsin, will split glycyltryptophan.

2. This ferment is destroyed by an acidity of .36 per cent HCl (equivalent to about 98 degrees of acidity as ordinarily determined).

3. The presence of this ferment may be of diagnostic value.

Their report was accepted with widely divergent criticism. Many investigators took up the study of the method, and obtained different results.

One of the most frequent criticisms is the fact that it was found that the gastric contents of normal individuals, as well as of non-cancerous patients, under certain conditions, was capable of splitting glycyltryptophan and other polypeptids. As an explanation of this fact, it is generally believed that the ferment causing this peptolytic cleavage belongs to the general group of ereptases, ferments capable of splitting polypeptids and peptones, but incapable of attacking native proteins. No specific action on the part of the ferment in cases of carcinoma has been observed, so far as the above cleavage is concerned; therefore, a test of this sort possesses specificity only in so far as it can be shown that the ferment present is derived solely from the carcinomatous tissue. This introduces a number of sources of error, and in order for the test to possess the slightest value, ereptases, or ferments, from the following sources must be ruled out:

1. Erepsin from regurgitated duodenal contents.

2. Ereptase from hæmorrhage into the stomach and from transudation of ereptase-containing fluids into the stomach.

3. Tissue ereptase from breaking down of cells of the gastric mucosa.

4. Ereptase in swallowed saliva.

5. In addition, protease, capable of peptolytic cleavage, as well as of proteolytic cleavage, may be present from the trypsin of regurgitated pancreatic juice, or from bacteria and leucocytes, mostly from swallowed saliva, and must be controlled.

Naturally, under these circumstances, the test becomes very difficult technically, and is not available for use by the general practitioner.

However, Friedman and Hamburger, in a recent communication, have so modified it that it holds promise of results, and more general applicability. They consider that, of all the above enumerated sources of error, the proteases of regurgitated pancreatic juice and the leucocytes and bacteria of saliva are the most active. They control these by the use of the vegetable protein edestin, which is attached only by proteid splitting ferments. They also use peptone in place of glycyltryptophan, which has been shown to be equally as good. Both peptolysis and proteolysis now come into consideration, whereas in the original test it was only peptolysis. High peptolysis with low proteolysis speaks for carcinoma; high peptolysis with high proteolysis against carcinoma. Under these circumstances, they think that the test possesses distinct value in the diagnosis of cancer of the stomach, and is of considerable service in the differential diagnosis between benign and malignant anacidity, but is of practical value only when taken in conjunction with the usual clinical and laboratory findings.

After all criticisms have been made, and sources of error ruled out, the fact remains that the gastric juice from cases of carcinoma in most cases undoubtedly shows a higher peptid splitting power than that from normal or non-malignant cases, and the routine employment of the test as originally described can do no harm, although no dependence can be placed upon it alone. But in conjunction with other clinical findings, it is a small link in the chain of evidence.

Another simple test has been suggested by Oppenheim. I have been able to find but very little on the subject in the literature at my disposal, and consequently cannot give any opinion as to its value. It consists in adding three per cent acetic acid to the filtered gastric contents, a drop at a time. If the reaction is positive, a turbidity or cloud appears which vanishes only after considerable acetic acid or a little HCl is added. Dilution with one to five volumes of distilled water does not cause the cloud to disappear. The only source of error is mucus, which also gives a cloud with acetic acid, but this cloud is unaffected by the addition of HCl and does not occur in high dilutions of the gastric contents. The filtrate must be absolutely clear. The test may be applied to vomitus, and blood and pancreatic juice are not disturbing factors. Oppenheim has made comparative tests, and finds the above reaction positive in all cases in which the glycyltryptophan test is positive. He is unable to determine upon what the reaction depends.

Still another test which has been proposed, in which stomach contents are used, is based on the presence of hemolytic substances in the gastric juice. Grafe and Roehmer first undertook this investigation, carrying on, in a way, the work of other men who had demonstrated the presence of hemolytic substances in extracts of organs and malignant tumors. The gastric juice, rendered feebly alkaline, was extracted with ether. From the residue, after evaporation of the ether, an emulsion was made with normal salt solution. This emulsion was then mixed with a suspension of washed rabbits' corpuscles. The extract from carcinomatous gastric juice dissolved the red blood-corpuscles, which action did not occur with benign diseases of the stomach, or in healthy persons. Upon further investigation, however, the test was found to be of little value for several reasons: the technique was too complicated and difficult for ordinary clinical use, the presence of trypsin in appreciable amounts also led to hemolysis, and in high-grade gastrectasis, on account of the large amount of water necessary for washing, the hemolysin was so diluted that hemolysis did not take place.

Through chemical analysis, it was determined that the hemolytic action was due to oleic acid. Grafe tried to simplify the method by determining the quantity of oleic acid by titration.

But after many trials of both methods, by many investigators, the conclusions of the majority seem to be that they possess little value, as hemolysis and high oleic acid content are found in many benign affections, and in health, and are often not found in cases of carcinoma.

These tests just described are typical and are among the most important of those which deal directly with the stomach contents, and are the ones over which most of the discussion has been. When all is said and done, they fall far short of furnishing the infallible test for gastric carcinoma which is the ultimate aim of all investigators. Of course, much work has been done toward refinements of the older methods of gastric analysis which cannot be discussed here. More stress is laid by some upon the finding of occult blood in the gastric contents and stools than seems formerly to have been the case. Zoeppritz states that the repeated finding of occult blood in the stools day after day, provided all extraneous sources of blood are ruled out, is the one sign above all others which is characteristic of beginning gastric carcinoma. In no other condition is it so constantly present.

But, in general, very little real advance has been made in gastric analysis. A large amount of information has been gathered, but it consists mostly of disconnected facts, and their general bearing on any one subject, and particularly on the one under discussion, is not yet clear.

We have now to consider the investigations which have been made concerning the general reactions and perverted metabolism of the organism in cancer.

Salkowski found that in the urine of patients suffering from carcinoma the percentage of nitrogenous matter precipitated by the metallic salts to the total nitrogen was greatly increased. While normally the so-called colloidal nitrogen amounts to about 3.5 per cent of the total nitrogen, in carcinomatous urines it was between 8 and 9 per cent. Later investigations gave the same results, which were confirmed by a few others.

Following this, many observers tested the method with varying results. It was found that a large number of diseases, in addition to carcinoma, showed an increase in colloidal nitrogen, notably chronic infectious processes, tuberculosis, heart insufficiency, and liver diseases. There were many differences of opinion regarding the percentage relationship in carcinoma. A few observers found no increase, but an actual decrease. On the other hand, many agreed perfectly with Salkowski, Caforio stating that carcinoma could be ruled out of the diagnosis if there was no increase in colloidal nitrogen.

Feuer, of Basel, from whose article I have obtained my information regarding this method, tested it in a large number of cases. He found that the reaction was absent in about one-third of the cases of undoubted carcinoma, and was present in a number of other diseases. However, this latter fact alone does not detract so much from its value if it were always present in all cases of carcinoma, because in most of the other cases the diagnosis presents no especial difficulty, with the exception of pernicious anæmia and some liver diseases, which are often difficult to differentiate from malignant disease.

He concludes that an increase in colloidal nitrogen occurs in all cachectic conditions, and that it speaks for carcinoma when all other causes of cachexia can be ruled out, such as chronic infections, tuberculosis, and heart and liver disease. A normal percentage, however, does not by any means exclude carcinoma.

Another and simpler urinary reaction, which is along the same lines as the preceding, and dependent upon the same principle, is the sulphur reaction of Solomon and Saxl. They find that the urine in carcinoma is fairly rich in incompletely oxidized sulphur, which sulphur they oxidize and determine the quantity of sulphate resulting. The general principles of the method in brief are as follows: The sulphates are removed with baryta solution, the ethereal sulphates by digesting with HCl, and the filtrate treated with hydrogen peroxide, and boiled. It is then placed in a conical glass. If positive, an abundant precipitate occurs within one-half to four hours. Normal urines do not give this precipitate in that length of time, or at most, only a trace. Any precipitate occurring after four hours is disregarded.

The literature contains many references to this test recently, the great majority of writers speaking very enthusiastically of it, although a few say that it has no value whatever. The general opinion, however, seems to be that it is positive in a large proportion of all cases of carcinoma.

Certain Italian workers, notably Ascoli and his pupils, have presented a serological reaction for cancer, based upon certain principles laid down by Ehrlich, and also upon certain laws of physical chemistry, by means of which they seem able to identify antibodies in the serum of the individual tested, when a specific antigen is employed.

In brief, the method consists of extracting the essential principles of the antigen, specific organisms, or diseased tissue being used, as the case may be, and adding this extract to the serum of the patient to be tested. The surface tension of the mixture is then ascertained. This is measured by the number of drops contained in a certain amount of the fluid, estimated by means of an instrument known as the stalagmometer of Traube.

The mixture is then allowed to incubate at body temperature, and at the end of a definite time the surface tension is again estimated. If it is increased, the number of drops in the same amount of fluid will be increased.

Ascoli claims that this increase will occur in every case in which an antigen is incubated with a serum containing an antibody, and claims a high degree of specificity for the reaction, particularly brilliant results being obtained by him in malignant disease. It occurs not only in malignant disease, however, but also in other conditions, such as typhoid, syphilis, tuberculosis, and most infective diseases.

As with the other tests, opinion as to the value of the meiostagmine reaction, as it is called, varies greatly, but a large number have confirmed

Ascoli's results, and the method, if simplified, would seem to hold promise. The technique, however, is at present much too complicated for general use.

Only a brief mention of other tests which have been proposed can be made here.

Recent developments in Abderhalden's biologic test seem to promise something, especially in determining the organ involved; the phenomena of anaphylaxis have been utilized to a slight extent as a means of diagnosis, but no definite ground has been reached; von Dungern has suggested a complement deviation reaction, which was claimed to be specific, but later researches have shown it not to be so; Sturrock finds the alkalinity of the blood increased in cancer, and on this finding alone feels justified in exploratory operation. His results have not been confirmed. The skin reaction proposed by Elsberg, Neuhof, and Geist has been found not to be specific, but a positive reaction is strong presumptive evidence of cancer.

One agent which is rapidly coming into prominence in the diagnosis of gastro-intestinal conditions is the X-ray. It is of course valuable only as an adjunct, as the diagnosis cannot be made upon the X-ray findings alone. But in the hands of experts it promises much. Serial skiagrams are necessary in order to be at all certain in any case.

In expert hands, too, the gastroscope is exceedingly useful, in many cases enabling an early and exact diagnosis, without the employment of any other means. Its employment is rapidly becoming more extended, and in the near future we may hope to see it in fairly general use, instead of being confined to a few.

The above are only a few of the many tests and methods which have been proposed in recent years. To discuss them all, would take too long. They fall naturally into three groups:

1. Those dealing with the stomach contents.
2. Those dealing with the urine.
3. Those dealing with serological reactions.

A fourth group might also be added, containing those agents other than tests directed toward the organism and its metabolism, as, for example, the X-rays and the gastroscope.

The above described are fairly typical of each group. Of these groups, the one which would seem to promise the most theoretically is the third. It is reasonable to suppose that the blood of patients suffering from malignant disease would contain a substance or substances not present in the blood of normal individuals, and the large number of able investigators who are at work on the problem would lead to hope that in the near future some specific test will be evolved.

But we must conclude that the test which fulfills the long felt want of an early specific diagnostic means for carcinoma is yet to be discovered, and that so far as the general practitioner is concerned, recent years have not helped him much, because those few tests which do supply a small degree of confirmatory evidence are too complicated and too difficult technically, except for those specially trained and with exceptional laboratory facilities.

Considering these things, it would seem that in cases of stomach disturbance presenting symptoms which lead to a suspicion of cancer, the patient should be told the exact state of our knowledge on the subject. The dangers of delay should be dwelt upon, and the individual given the opportunity to choose between uncertainty and an absolute diagnosis, which can be obtained only through an exploratory operation. The risk is small, and the information is definite. If the condition is found to be inoperable, the patient will have suffered but little additional pain and discomfort.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

A Regular Meeting was held March 6, 1914, with the President, Dr. M. L. Harris, in the Chair

Dr. Edward J. Lewis (by invitation) read a paper entitled "Preliminary Report of Experimental Bone Transplantation." (See p. 572.)

Dr. Edwin W. Ryerson (by invitation) read a paper entitled "The Transplantation of Bone in Pott's Disease." (See p. 578.)

Dr. E. J. Brougham and Dr. A. C. Ecke (by invitation) contributed a joint paper entitled "A Preliminary Report on the Treatment of Fractures by Fixation with Animal Bone-Plates and Bone-Screws." (See p. 637.)

Dr. H. B. Thomas (by invitation) read a paper entitled "Bone Transplant." (See p. 580.)

DISCUSSION

All of these papers were discussed together.

Dr. William Hessert: Bearing upon the subject of bone transplantation, I have had a patient come here to-night who represents a typical case of osteomyelitis, followed by necrosis, resection, transplantation, with a pretty fair result.

This boy first came under my observation in September, 1911. He had been sick five days with a classical history of osteomyelitis—sudden onset, excruciating pain, fever, with chills, and all the symptoms of sepsis. After five days his leg presented the typical appearance of swelling, extreme tenderness, and central fluctuation. An incision was made on the anterior aspect of the tibia; pus was found in the soft tissues and under the periosteum. At that time I opened into the medullary cavity. The suppuration subsided, the acute symptoms subsided, and the boy became immediately better, and after six weeks the lower epiphysis had become loose.

A question of practical moment is, How long shall we wait when we have complete necrosis of the shaft of the tibia before removing the necrotic tibia? Shall we wait until the tibia becomes loose, or shall we take out the necrotic bone early? I waited five weeks and the lower epiphysis having loosened up I determined on resection inasmuch as the osteomyelitic process was limited to the lower half of the bone. The entire shaft of the bone did not become necrotic, due to fairly early intervention. How much of this necrotic tibia are we to remove? In other words, how can we tell how much to remove? Does it make any difference whether we remove quite a bit of healthy bone, there being no line of demarcation? I was more or less guided by the formation of an involucrum, and from this point the periosteum was not thickened. I severed the bone at that point, and whether that is correct I should like to have some expression of opinion. That was what guided me as to the point of resection.

The subsequent history was uneventful. The wound healed up completely in about a month; there was no sinus, and I waited in this case for about a year and there was no regeneration. After six months I advised transplantation, but his family was opposed to it, and they waited for another six months, and during the greater part of that time the boy was around without a cast, and as a consequence the fibula became partially dislocated. After a year there was no regeneration. I was able to identify the periosteum in this subperiosteal resection, and thought at the time of the resection there was some regeneration, but the first picture shows there was very little. After a year a typical transplantation was made. A piece of bone eight inches long was removed from the left tibia, and three-quarters by one-half inch thick; I used the chisel and it worked nicely. With a sharp thin chisel one can chip off the desired length. This shows the site of transplantation, and has regenerated so that he again had a sharp tibial margin here.

The pictures shown illustrate the appearance of the bone subsequent to the first operation. For the next year or so there was just a little projection from below and a slight one from above. This shows the site of the removal of the graft. This shows the graft in place shortly after it was inserted and the subsequent pictures were

taken within six months after the transplantation, showing adhesion of the transplant to the tibia, the transplant having been removed in the manner indicated with a chisel, which is more or less crude as compared with the saw, but it can be done with fair accuracy with a thin, sharp chisel without the danger of spoiling the graft.

The ends of the bone were squared off. The graft was driven into the medullary cavity above and fastened below with wire. I believe that the bone-graft does not die. I have nothing but clinical evidence, but from this and my study of the literature I believe it is a fact that the bone-graft does not die. I am convinced that when a bone is transplanted a great number of the osteoblasts remain living and retain their function and that they contribute toward the growth of the bone. This graft has grown somewhat. Subsequent to the transplantation the course of the clinical history has been uneventful. I kept him in a cast for four or five months and since that time he has been walking. He went around for nearly six months with the absence of the bone there, with nothing to support it, and forced it into this position; at the same time the result is pretty fair.

I simply present it as a case of transplantation of bone following resection for osteomyelitis.

DISCUSSION

DR. ARTHUR DEAN BEVAN: We have all profited very much by this symposium on bone transplantation.

In regard to Dr. Lewis' paper, it is the clearest, most common sense presentation on bone grafting or bone transplantation I have listened to. I say that because it is entirely in keeping with my own conception of the facts. I never had any question in my mind but that exactly the same laws controlled bone grafts that control a Thiersch graft or a graft of fascia; that we simply have to look to exactly what happens in the transplant of a Thiersch graft or of a graft of fascia to determine what takes place in bone. I believe bone is simply a mesoblastic structure, peculiar to be sure, and that the peculiarity lies in the osteoblast, which has the power of reproducing mesoblastic connective tissue of that particular form called bone, and that the whole subject of the success of the graft and its condition depends upon the life of the osteoblast. If the osteoblast is placed in a condition where, as Dr. Lewis states, it can receive the proper blood supply, favorable conditions for life and growth, it will live.

The experiments he has detailed are interesting to me, and particularly those relating to cutting these bone fragments into a great number of pieces and transplanting them and demonstrating beyond any question of doubt the fact that they do live; that the osetoblasts do live and do develop into bone. This is especially shown in the case where he cut off the ends of the radius and turned the lower end of the radius into the joint. There can be practically no doubt but that the bone graft does live in that particular case.

I am very much interested in Dr. Ryerson's work, and particularly in the very practical motor saw which he has demonstrated to us this evening. It seems to me it is the most successful instrument I have seen for work of this nature.

In regard to the bone-plates, I cannot quite agree with the authors who presented this subject. The bone-plate presented seems to be an admirable device. I want to say in that connection in regard to Dr. Thomas' paper that I think he is incorrect in the statement that forty-eight per cent of the Lane bone-plates suppurate and require removal; under favorable conditions the percentage of suppurations in steel plates, properly introduced, would be very small—so small that there is hardly a fair comparison between the cases which he presents of transplanting bone into a vertebral column or any other position without any suppuration. The whole question is one of technique and of the condition of the tissues in which you make the transplant. Certainly under favorable conditions a surgeon who has ten per cent of cases that suppurate in using bone-plates would be very culpable. I cannot say offhand, but I do not believe in my own bone-plating we have had anything like five per cent of cases in which there has been any infection of any kind.

In our own work in the femur we practically never remove a steel plate. In the tibia it may seem advisable in some cases to remove the plates; where it is advisable we do so, and regard them simply as a temporary matter. They can be easily removed under a little local anæsthesia and with very little difficulty. My own impression is that where we need a plate of any kind, a steel plate in fractures would be better than a bone plate such as that presented, although I think these bone-plates should have a fair trial.

DR. CHARLES DAVISON: I have been very much interested in this work. I have watched very closely the work that has been done in the County Hospital, particularly the Albee operation, and the results seem quite wonderful. The children sent there go from bad to worse by the old treatment.

One point raised against the Albee operation is that the fixed bone-splint put in a child will not grow with the child; that it will straighten the back up too much. These cases shown to-night, growing for a long time, would not indicate that.

As to the application of the Lane plate, the Lane plate is a foreign body. It is admitted by those who have been around the County Hospital, and have seen a good deal of the surgical work done there, that many of the Lane plates that have been used have been subsequently removed, and there have been all sorts of results following the use of this plate. Three or four years ago, or shortly after the Lane plate was introduced in this country, there was a steady stream of cases coming to the County Hospital with infection from Lane plates, or rather in those cases where Lane plates had been used. Some of these patients would come in for a day and have the limbs dressed, while others would come in to have the plates taken out. Still others would come in transit to the Oak Forest Infirmary. In the use of the Lane plate, when infection takes place, the screw holes make necrotic areas which are slow to exfoliate, and new bone built up around the plate takes a long time to get well. It seems the Lane plate is passing, as so many surgeons are using other devices for the same purpose. I am in favor of the autogenous bone splint in the medulla of the long bone, taking a little chuck out of the tibia and introducing it into the medulla of the bone; this can be done much quicker than a Lane plating. It is done quickly with a saw, with very little shock to the patient, and the bone splint will slip in place easily, and we have a splint which belongs to the body, and which will be treated kindly by the body. It does not make any difference whether it stays there or becomes absorbed: it will remain there long enough for the fracture to unite. It *probably* will undergo the same process as a physiological medullary bone-plug after bone fractures. After the bones are knitted together, there will be gradual absorption and reopening of the medulla as time goes on.

The open operation for fracture of the long bones has a very brilliant future, but I think it is being overdone. It is being used on bones that should be treated by simple splints, by simple reduction and fixation by ordinary splints. Any bone that can be successfully fixed by ordinary external splints should not be subjected to an open operation which is attended with the dangers of infection. A simple fracture of a long bone can be fixed by a bone-peg taken from the tibia, with better results than with any other device by open operation.

Dr. A. J. Ochsner: The scholarly paper read by Dr. Lewis certainly has great value and it is gratifying to know that such work is being done here.

The more we have seen of the Albee operation the better we have been pleased with it. The patients as a rule have shown great improvement.

Regarding the case that Dr. Hessert has shown us, I believe that if all the tissues had been split down to the bone from a point three or four inches above the place where the incision was begun down to the lower point at which the incision stopped, and the leg had been dressed for a year and a half, the patient would now have a leg infinitely better than he has. I have not seen as many of these deformed cases following acute osteomyelitis operations in recent years as I did formerly. Some twenty years ago a case came under my care with the metatarsal bone of the great toe entirely necrotic; I made an incision and wanted to remove the bone but was not permitted to do so. That patient still carries her metatarsal bone of the great toe and there is no shortening or deformity whatsoever. I have seen the tibia necrotic for more than one-half of its length remain in place with the loss of only a small amount of tibial tissue. I have seen a number of cases like the one we have seen to-night in which new bone formed as a sequestrum by not removing the dead portion until later and invariably the result was much better than in the case just shown.

Regarding bone plating, I would like to say this: No one should plate bones unless he knows how. If bones are plated right, it is one of the best operations in properly selected cases that can be done. If you plate a bone wrong, it is one of the worst things you can do. In our bone work at the Augustana Hospital, Dr. Percy has had 108 consecutive cases in which bone plates were used, with only five unsatisfactory results. The difference between the manner of applying these plates and those I have seen that were put in elsewhere and had to be removed later is precisely the difference between a thing done right and a thing done wrong. If one watches those who do it right and those who do it wrong, it is a simple matter to see why in one case the plates have to come out and in the other cases they do not.

Dr. E. J. Brougham: In regard to Dr. Bevan's statement that suppuration has occurred in only five per cent of the cases in which plates have been used in his work, I would say that in

the literature we found a much larger percentage. It is that percentage we hope to do away with if the bone is absorbed. By the animal bone-plate we try to eliminate that percentage of trouble and do away with the necessity of having subsequently to take out the plates.

DR. H. B. THOMAS: My statement regarding the Lane plate was that in one series of cases studied it was found that forty-seven and seven-nineteenths per cent were removed at a subsequent operation.

DR. BEVAN: They were not Mr. Lane's series?

DR. THOMAS: It was a series of cases studied at the County Hospital. I believe that the autobone-plate will in a few years be used extensively, and probably if Dr. Ochsner has so low a percentage of suppuration as four per cent in his cases, with the Lane plate, he might have none by the use of the autobone-plate.

DR. BEVAN: That would not represent the average work?

DR. CHARLES DAVISON: I think the surgical work done at the County Hospital would fairly represent the work done throughout the country. Of course, Mr. Lane is an expert in putting in these plates, but I have known cases in which Lane plates had to be removed a long time after Lane himself had put them in.

DR. OCHSNER: While in England a great many surgeons were asked if they had taken out any Lane plates that were put in by Mr. Lane himself, and there was not one of them who had taken out a single Lane plate.

DR. THOMAS: I do not intend to convey that my report represents the average per cent of Lane plates removed: it represents the results in the records reported on. It is known that some patients died before the plates could be taken out. Regarding the County Hospital, those on the staff who do work there are men who have secured their positions by civil service examinations and are considered well qualified.

DR. BEVAN: I would not like to leave the impression that I am criticizing the surgical work done at the County Hospital. Not at all, but I do not think the statement that it is necessary to remove Lane plates in forty-seven per cent of the cases on account of suppuration is a fair statement of anything like the possibilities of the Lane plate, because we do not know all the other facts in the case. Possibly many of the Lane plates referred to may have been put in in compound fractures. It is well known that Lane himself never puts a plate in a compound fracture. The percentage mentioned does not represent the possibilities of clean aseptic work with Lane plates, and I think Dr. Ochsner's statement is quite correct, that where the work is well done without any preceding suppuration, three or four per cent would represent nearer the facts than forty-seven per cent.

DR. CHARLES DAVISON: I think an error in the percentage comes from a misunderstanding of the facts. A great many cases come into the County Hospital with the plates already in, and these probably are included in the statistics. In many of them the wounds are suppurating and the patients are in bad shape.

DR. THOMAS: To repeat, my point is simply this: I had a trained nurse under my supervision, a woman of intelligence and considerable education, look over 450 histories in Cook County Hospital; from these, which were the fracture cases for several years, those in which the Lane plate had been used were studied and the percentage I have mentioned determined. I grant you, that had the records of many hospitals been considered, this percentage would be too large. It occurs to me after what has been said and from the results that I have given you, the autobone-plate will after a while take the place of the metal plate, because it is not foreign material, and in a large number of cases in which bone-splints have been used they have remained and have done the work.

I believe that more cases are plated than should be. In those that should be plated use the autobone-plate when possible and you will get better results with less careful technique.

CHICAGO GYNECOLOGICAL SOCIETY

A Special Meeting of the Society was Held during the Week of the Clinical Congress of Surgeons of North America, November 15, 1913, with the President, Dr. Frank W. Lynch, in the Chair

Dr. L. S. McMurtry, of Louisville, Kentucky, read a paper entitled "Hysteromyomectomy: Its Evolution and Perfection." (See p. 556.)

Geheimrath Professor Dr. Krönig, of Freiburg, Germany, followed with a paper by invitation entitled "The Difference between Former and the Newer Treatments by X-ray and Radium in Gynecological Diseases." (See p. 529.)

DISCUSSION

Dr. Charles E. Paddock: We are to be congratulated on having with us to-night as our guest such a distinguished professor in medicine, and I am sure we have all profited by the scientific address to which we have just listened. Especially was I interested in the statistics given in the use of scopolamine and morphine in labor. The report is so at variance with my own limited experience that I am at a loss to understand it.

A few years ago the medical literature contained many reports from individual practice and large clinics upon the use of scopolamine and morphine in obstetrical practice, and while many of these were as favorable as those of the essayist, as many more were decidedly unfavorable.

At this time I gave it a fair trial and the result was so disastrous that I nearly discontinued the use of these drugs in confinement, and now use them only for those very few selected cases where I believe them to be indicated, such indication arising in only about one-tenth of all obstetrical cases in labor.

My objections to the use of these drugs are, first, that we do not always get the result expected, the drug acting differently at times; second, it retards labor and frequently results in the termination of the labor by the use of forceps; third, the injurious effect upon the baby, as in many cases the baby is born in profound asphyxia; fourth, the danger of post-partum hæmorrhage.

I will merely cite one case which illustrates my experience in several. The patient, a primipara, was given 1/150 gr. of scopolamine, and 1/6 gr. of morphine in the early stage of labor. In a short time the pulse went to below fifty, the respirations to ten per minute, and the face was alternately flushed and cyanotic, the patient delirious most of the time. This continued, as I remember it, for many hours, with a final cessation of labor pains and a final resort to the use of forceps. The baby was born in asphyxia, and could not be resuscitated. This was in a private family and to this day I am called the murderer of that child.

The above report is probably an exaggeration of the others where I have met with failure in the use of the drug.

The principal fault I have to find in the use of these drugs is the effect upon the baby, and I am surprised that the essayist has not had such an experience. Nearly all of the babies in my experience are born in asphyxia, and many of them are with great difficulty aroused and occasionally they are born dead.

Dr. Rachelle S. Yarros: I am exceedingly interested in the subject that has been brought before us. In this country we have not given sufficient attention to it. We find a great many of our women are easily exhausted in labor, and we have to use instruments quite frequently. I do not know, but perhaps the American women, of the upper classes, are different from the German women who belong to the upper classes; but I have felt that we have not given sufficient attention to the use of scopolamine and morphine in obstetrics.

I have used these drugs in a number of cases, and have had an experience similar to that related by Dr. Paddock in two cases. First of all, we use scopolamine-morphine in the same doses we do in surgery, namely, 1/100 of a grain of scopolamine, and 1/4 of a grain of morphine. We use it at intervals of an hour, mainly in the middle of the first stage of labor. The women are made comfortable, but labor is prolonged in multiparæ. In primiparæ we were not able to determine the value of the method. The internes complained bitterly that they never knew when the case would come off, and that was one great objection. The reason why we gave it up was this: First of all, we had three badly asphyxiated cases. The fourth one we lost. We could not resuscitate it. We decided on the use of oxygen as soon as the baby was born.

In private practice, where we do not have oxygen, I would be afraid to use these drugs.

I should be very grateful to Professor Krönig if he would tell us the exact time when he begins to use these drugs and the dosage. It is very essential that we should find some method by which we can diminish the pain of labor, because I believe that the modern women cannot stand as much pain as the women of the past.

Dr. Robert L. Dickinson, Brooklyn, New York: As one who has used scopolamine-morphine and then abandoned the method because of the difficulty of resuscitating children; as one who has visited Professor Krönig's clinic, and again taking it up under better instruction, I desire to speak on this subject, although the new series of cases is not yet sufficient to determine whether our babies are in greater danger. We have oxygen always at hand. A distinction between the old method and the new has perhaps not been made by Professor Krönig, but as I understood it at Freiburg, there is an attempt made to have a definite interval of four or five or six hours between the last dose of morphine and the delivery of the child. Of course, no man can tell just exactly what that interval is, but certainly in our experience, giving morphine in the early part of labor, as was taught in Freiburg last year by Professor Krönig, has made a difference in the number of asphyxias.

Dr. Gustav Kolischer: I think that Dr. Yarros struck a keynote when she said that the American woman of the higher class cannot be judged by the physical standard of the average women who are furnishing the material for the German clinics. But the untoward results of the scopolamine anæsthesia that Dr. Yarros is reporting may be sufficiently explained by other factors also, the same factors that brought this anæsthesia somewhat in disrepute with most of the obstetricians here in Chicago. We saw collapses in the mothers and certainly an increase in the mortality of the babies. There are two instances that may be held responsible for that. Firstly, the scopolamine that was at our disposal was a rather uncertain drug: the preparations on the market were of different strengths and were also unstable; they decomposed rather rapidly and some of the undesirable results were undoubtedly due to this changed quality of the drug. We were given to understand, however, that Professor Krönig's chemist furnishes a preparation that is equally reliable in the whole output and is also absolutely stable. Secondly, there is an essential difference between Krönig's dosage and the doses we were used to administer. We, and so did Dr. Yarros, always injected one milligram scopolamine per single dose while as I understand it Krönig administers less than one-half of one milligram as a single dose. Neither scopolamine nor morphine is known to have an accumulative effect, so that the toxic effect of the first dose may have worn off before the next dose is given. If we give at intervals the same amount in two or three doses that we used to give in one dose, this point is sufficient to explain the difference between Krönig's and our results.

As to the radiotherapy of myomata of the uterus, a criticism of this method depends entirely upon the standpoint one is taking as to the remote results of operative interference in sarcoma of the myomatous uterus, and as to the primary mortality of myomectomy. If one believes that we are able to obtain definite cures by operating on myomata that have degenerated into sarcoma, then one may object to the indiscriminate radiotherapy of the myomata of the uterus. At the same time we have to admit the possibility that a sarcoma contained in a myomatous uterus may have been cured and may again be cured in the future by the influence of the X-rays or by mesothorium rays, or, as we were recently told, by the action of a hundred thousand dollars' worth of radium.

As to the primary mortality of myomectomy I would like to call attention to the fact that conclusions based on statistics must always be taken with a grain of salt. While Krönig figures the total primary mortality to vary between four and five per cent, it still is a fact that some operators can look back on long series of operations without a single death. Dr. Frankenthal who is operating at the Michael Reese Hospital reported some time ago an unbroken series of 125 myomectomies without a single death. Of course the objection may be raised that such an absolutely favorable series may be followed by a number of bad results; but still, facts are more convincing than mere theorizing.

There is one feature, however, that may help us out of these difficulties: modern laboratory work has developed a way of diagnosing malignancy that could not have been diagnosed by any other clinical evidence, and that is the serum diagnosis of malignant tumors. If the promises held out by the laboratory men will come true, then all these dilemmas will be solved. In case the serum test points to malignancy, the believer in the operative cure of uterine sarcomata will resort to the knife and will shun the radiotherapy; if, on the other hand, the radiotherapeutist will have succeeded in making disappear a uterine

tumor under similar conditions, then his claim that malignant tumors of the uterus may be cured by hard rays without the risk of an operation will be definitely established, and if that is done a great step forward will be assured and for this enrichment of our therapeutic armament we will be indebted to the Freiburg clinic.

PROFESSOR KRÖNIG (closing the discussion): With reference to the remarks of Dr. Yarros, I will say that while the American ladies are more beautiful than the German ones, I do not think they show less resistance. I think the German and American women are about equal in that respect, because I have had the good fortune of having delivered quite a number of American women under scopolamine-morphine narcosis without mortality incident.

Dr. Kolischer has stated that in former years the scopolamine was not a constant entity; that it was liable to decompose rapidly and in decomposing it not only became inefficient but developed new and dangerous properties that endangered the lives of the children. In our first thousand cases we almost lost three women from the effects of decomposed scopolamine, but since our chemist has been able to furnish us with a stable, reliable drug of equal strength, in three thousand cases we have not lost one mother. The mortality in children did not increase above the general mortality in the first year. Therefore, if Dr. Paddock's results differed so widely from ours, it is fair to assume that his technique must have differed somewhat from ours, or that he had the misfortune of using an unstable or decomposed drug.

As to radiotherapy in the treatment of myomata of the uterus, I would like to say that according to the statistics collected by us, the percentage of sarcoma in uterine fibromyomata is not more than one per cent. In fact, of those cases of myomata that were treated with X-rays, we did not lose one case by sarcomatosis. Statistics show that of all cases that were operated radically for sarcoma of the uterus, 33 per cent were dead inside of three years, all of the patients having died from recurrence of the disease.

PROFESSOR DOCTOR GAUSS, Freiburg, Germany, read a paper entitled "Report of the Result of Radiotherapy in Gynecology."

DISCUSSION

DR. LEWIS S. MCMURTRY, Louisville: My contribution to this symposium was an effort to present the development of the surgical treatment of uterine fibromyomata preparatory to the paper of Professor Krönig, to the delivery of which we have just listened, in order that we might have a thorough presentation of the present status of the subject, and then be able to apply the suggestions that have been so ably and germanely presented. This is not the first time, Mr. President, that an effort has been made to replace surgical methods by non-surgical methods in the treatment of uterine fibromyomata. Those present will remember the efforts of Professor Apostoli in this direction with electricity and of Dr. Keith after his great surgical triumph in this field, who abandoned surgery and adopted electrical treatment.

The difference in the suggestions made by Professor Krönig as to the non-surgical treatment is very marked. Professor Apostoli at the time he advocated this treatment had never successfully treated these cases by surgery, while the other had abandoned surgery; but here in advocating the treatment of these tumors by the röntgen rays we have a masterful surgeon, who has had experience in surgery, and who presents these facts to us. Those of us who have visited Professor Krönig in Freiburg, and have witnessed his work, can all realize that when he speaks on this subject we are listening to a master surgeon, consequently when he makes suggestions as to supplanting established surgical methods with another method, it commends itself to our careful consideration. It is certainly a very remarkable presentation of facts, and I am sure that we are all very greatly indebted to him for presenting this very scientific paper. Before this treatment can be properly tried, it requires one to master the technique as has been done by Professor Krönig, and to conduct the treatment with the greatest care, precision, and with scientific accuracy.

I have no doubt, as a result of Professor Krönig's visit to this country, this treatment will be thoroughly tested here, and I trust with the most satisfactory results.

DR. ROBERT L. DICKINSON, of Brooklyn, New York, followed with a paper entitled "Efficiency Engineering Applied to Gynecological Surgery," which was illustrated by numerous stereopticon slides. (See p. 559.)

DISCUSSION

DR. RICHARD R. SMITH, Grand Rapids, Michigan: This is a very timely paper, full of thought and suggestion by a man of large experience. Dr. Dickinson is, above all things, a practical man, and he has that far-seeing imagination which makes for progress. I think we have all been pleased with the progress gynecology has made

in the past years in lowering the mortality rate, bettering all our final results, as has been pointed out by Dr. McMurty to-night; but we are not satisfied and should not be, for there is still a great deal of room for improvement, not only in reducing the mortality and improving our results, but in making the ordeal of operation and the time in hospitals a less trying one. If we are to do this we must make still further progress; we must study more carefully our hospital efficiency not only in the operating room, but in every other department of the hospital. If we will remember efficiency in any line of business, as has been brought to our attention so much of late, if we compare hospital efficiency with the high standards attained in business, we will not be satisfied.

There are many things in hospitals that one might speak of, but I wish to speak of one thing particularly; and that is, service in our hospitals is in line with what Dr. Dickinson has had to say with regard to standardization. We have been prodigal of the time and efforts of those who are working in our hospitals, more particularly our nurses, and little thought has been given to the cutting down—to simplifying the work of our nurses. The giving of a few enemata, a few douches, always running back and forth from the drug-room, the sleeping room, etc., really consumes a forenoon for the average nurse, and a little thought directed to this would simplify the matter. I mention this to show that there is a tremendous waste of time and energy. If we could give it the thought required, we would not only improve our hospital work, but our patients would be better off, it would give our nurses more time for study and recreation, and we would be able to lead a far more rational life. So much for the nurse's work in the hospital.

When we come to the operating room we find the same waste of time on the part of the nurses and assistants. One man recently in one of the largest clinics in this country watched the work of the utility nurse for a forenoon,—the nurse who does the work about the room,—and he counted the steps she took during the forenoon in going back and forth. Besides the manual labor she accomplished, she walked four miles. It does not seem as though that is necessary; and surely it cannot be; it should be and will be cut down.

When we come to study the work done by the assistants—how many assistants are really necessary to do efficient work, to do thoroughly rapid work, and thoroughly good work? If we are to arrive at a conclusion, we must study the work that has been done in various clinics. Dr. Dickinson has pointed out the necessity of introducing these things in clinics. Jones, in Liverpool, England, operated upon twenty orthopedic cases in a forenoon, with but two assistants. Everything was simple. Everything went off rapidly and the work was beautifully done. On the other hand, in one of the most brilliant clinics here we saw a large number of assistants, with a great deal of confusion, so that literally they were falling over each other. These things must be and can be standardized. We must get down to something more simple. One thing that is necessary to bear in mind is the fact that work in a hospital is largely done by the women, and necessarily this must be so. Every surgeon knows what is needed to take hold of these problems and to improve them, and I only call attention to these things because I feel very strongly the necessity of studying this subject both in the operating room and as a practitioner.

Dr. John A. Hornsby was asked to take part in the discussion. He said: We hospital administrators think of two or three things in connection with hospital progress to-day. First, while it is not a part of our business to tell you how to do your work, we have our own opinion about it, and one of the things we think is not quite as modern as it might be is the getting of patients back to bed in good enough shape. We administrators think you ask us to take care of your desperate cases when they get back to bed. That means one of two things: you have taken too long to do the operation, or that we have not done our part in the operative technique that has permitted you to do your work fast enough. We are not going to inquire at this stage of the game which it is.

Another thing we find is this, that surgery varies. Some surgery is done with two and one-half per cent carbolic acid spray, and from this we come all the way down to the fancy needle work of Dr. Dickinson. We find this to be true: You have grown in your surgical operative technique from one nurse and possible one interne (the interne being a luxury), clear down to the point now where the gynecologist is commandeering three nurses and three internes, and some sort of an anæsthetist. There are six people and the operator. We find from our standpoint that we are in each other's way,—I mean the internes and the nurses,—and yet you are calling for more, more, all the time. That is due to one or two things—and we are going on the assumption it is our fault, the administrative side of the work. Probably you have been going so fast and doing

such splendid surgery in these last few years that you have not stopped to think about our part of it, and the result of it is that in nearly every operating room I go into to-day there is the command of the surgeon to "hurry, hurry, get this quick, get that quick." We do not believe that the work is done in such a workmanlike manner from our standpoint that the best results to you are being obtained. I have seen in some parts of this country, and know of places abroad, where an operator will have but one assistant, one woman assistant or a man assistant, and he seems to go through his operation without any friction, without any trouble. He operates quickly, he gets through, and gets his patient back to bed, and nobody is worried at all. When we see that, we wonder whether it is not a mistake to call for more people, more tables, more wash basins, more instruments, and the infinitude of apparatus and detail so that you cannot move about in the operating room at all. Now, I am not going to say whose fault it is. I do not know. That is not my business. But some of us a few years ago undertook to begin to ask that question. We have got to this point now and I am going to tell you very briefly what we have done. We have a hospital section in the American Medical Association. We had been working for some years in the American Hospital Association, but we were not reaching the right people—the doctors—who eventually must direct the affairs in hospitals if they are to be conducted along scientific lines, and you may as well begin that direction now. You have not done it up to this time. As I have said, we have a hospital section in the American Medical Association, and we have a similar section in the American Hospital Association, which also has a committee. At the meeting of the Clinical Congress of Surgeons of North America a committee was appointed to coöperate with the other two committees, of which Dr. Codman of Boston was chairman. I am chairman of one committee, and Dr. Hurd, of Baltimore, is the other chairman. Now, we are going in all directions to see if we cannot get some inspection of hospitals with a view of establishing standards by which the hospitals themselves may further their efficiency. One of these propositions was that the hospital people should undertake to inspect and standardize the hospitals themselves. That seems obviously impossible to be done. You cannot standardize yourselves. Then it was proposed that the American Medical Association should begin standardization and do this work. And again it came up, but the doctors are really the people who are at fault and they cannot standardize themselves very well. Then the proposition came up that inasmuch as the Carnegie Foundation had done such a brilliant piece of work in connection with medical education, it should undertake this work. That proposal is still in the air. Then again, the proposition came up to ask the United States Public Health Service to make an inspection of a certain class of hospitals with a view to establishing these standards. Just what we are going to do it is impossible to say. We are going to do something. The hospitals are going to have some help.

I receive letters every day asking what is the ethics of this, what is the standard of that, and what is the technique of the other? I do not know, because in the hospital with which I was connected for some years, I found that one surgeon wanted one thing done in one way, and he needs five nurses and three internes; another surgeon wants it in another way, although he has less assistance and more apparatus; so that there is no head nor tail to it, and we are trying to get something out of the chaotic condition in our hospitals of to-day. This does not confine itself at all to the surgical department. It goes into every part of the hospital administration, organization, equipment, and architecture. I bespeak for this problem of ours the earnest support of the whole profession everywhere. We have not had much of your support or interest in this matter in times past. We have not had your presence at any meeting of our sections or at our association. We cannot get anything from you but complaints. We have tried earnestly and faithfully to get you to attend the meetings of the hospital association, but you do not do it. You only stay at home and quarrel with what is being done. It occurred to us that if we invited you to attend the hospital section of the American Medical Association, we could talk over our troubles and correct them, but you do not attend this section as you ought to do. You stay away. The hospital section at Minneapolis was composed of about fifty people, this year. I will venture to say that not nine members in actual practice attended our section, and yet you are asking us for a tremendous lot of work and more and more every year. We know you need it; we want to give it to you, but we must have some sort of order.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

By M. G. SEELIG, M. D.

AS a rule, and for self evident reasons, third or later editions of any medical volume claim scant attention from the reviewer. An exception must be made of the fourth edition of Cripps' work, in order to note certain standard types of excellencies which cannot be emphasized too often. The volume[1] itself and its general make-up are so well and deservedly known as a classic that detailed comment is superfluous. There are nineteen chapters in all, the last four devoted to cancer of the rectum, and the first fifteen to anatomy, methods of examination, malformations, hæmorrhoids, prolapse, abscess, fistula, ulcer, fissure, stricture, pruritus, impaction, polypus, villous tumors, and sacral tumors.

The tone of the book, one is almost tempted to say the very feel of the book, lends assurance that here is a special subject treated by a man that commands the fields of general surgery and pathology. The volume is what it is, because it furnishes adequate information based both on fundamental principles and extensive personal experience, and clothed in pure and simple English, a recipe that will inevitably produce a good book. But Cripps has added two other ingredients: he has selectively described views and methods other than his own, thus making a good book a full book, and he has skillfully furnished just enough of the leaven of human interest and humor to make the full book a readable book. His illustration of the inconvenience caused by prolapsed hæmorrhoids in the case of the barrister who was so frequently the subject of this accident when he rose to address a jury, his warning against using harsh paper to cleanse the anus after stool, with the added caution that the printer's ink used on radical newspapers is particularly irritating, and his vivid description of an impacted jam pot in the rectum make the book one to be read rather than merely to be consulted.

The chapters on Cancer of the Rectum are admirable in so far as the clinical descriptive side is concerned, but totally inadequate from the point of view of modern operative technique; the transsacral and the abdominal route operations are dismissed with a few words and the description of his own operation smacks of surgical days long past.

[1] On Diseases of the Rectum and Anus, Including the Sixth Edition of the Jacksonian Essay on Cancer. By Harrison Cripps, F. R. C. S. Fourth Edition, New York, The Macmillan Company, 1914.

PROFESSOR BRYAN[2] has written a handy, presentable, fairly well illustrated volume of some six hundred odd pages, on the Principles of Surgery. He has, with almost meticulous care, adhered to the formal manner of treating the subject, under the various heads: Asepsis, Wound Healing, Inflammation, Gangrene, Ulcer, Sinus, Fistula, Burns, Tumors, etc., etc. The sum total of the effort is a fairly readable and accurate presentation of a well classified mass of surgical data. As far as the essential facts are concerned, none of them are open to question; in many instances, however, additional facts might have been furnished by way of confirming old, or establishing new principles. For example, under gangrene, mention might have have been made of the recent excellent studies of thrombo-angeitis obliterans; the work of Meltzer on magnesium sulphate as a motor depressant should have been incorporated under the head of tetanus; in the chapter on rabies, a few words should have been added to make clear the distinction between street virus and fixed virus; the principles underlying shock should have been stated more fully; in discussing burns, some mention should have been made of the vast amount of investigative work done on the effects of the absorption of altered proteids; and under the head of anæsthesia mention at least should have been made of the intratracheal method.

All this, however, constitutes suggestion rather than criticism. The constructive critic must see, and therefore must needs point out, the all-important fact that Professor Bryan has entitled his volume "Principles" and yet has so far failed either to state specific principles, or to emphasize their importance, as to rob the volume of the character connoted by the title. For example, if we contrast the chapter by Bryan on bacteria with the recent Harvey lecture by Vaughan,[3] we note that Bryan in forty-five closely packed pages fails to state what Vaughan says, in a paragraph, regarding the essential principles governing bacterial action and tissue reaction. Why confuse the student with the false notion that an accurate classification of bacteria constitutes the enunciation of a surgical principle? Under the head of asepsis and antisepsis there

[2] Principles of Surgery. By W. A. Bryan, A. M., M. D. Philadelphia & London: W. B. Saunders Company, 1913.

[3] J. Am. M. Ass., 1914, Feb. 21.

is not even a hint at the all-important principle that an antiseptic sufficiently potent to destroy vegetable (bacterial) cells is equally powerful in destroying cells of the human body; furthermore, the principle of osmosis as a factor governing the penetration and hence the effectiveness of germicides is not mentioned; if we may credit very excellent experimental work done abroad and careful work done in America, 95 per cent alcohol is a far better antiseptic than 70 per cent or 50 per cent alcohol, because the stronger the percentage, the more active is the osmotic power, and yet Bryan restates the old dogma of 50 per cent efficiency.

Under the head of inflammation we may very properly consider, from the practical as well as the philosophical point of view, that the most important principle lies in the fact that inflammation is a constructive and conservative rather than a destructive force. Bryan elides this fact. The important principle underlying shock is that all the vital body functions are compromised. This is a broad generalization that finds no emphasis at Bryan's hand. A most important practical principle in hæmorrhage is the fact that the white blood count goes up, even before the red blood count goes down. Bryan does not state this, even by way of differentiating shock from hæmorrhage. Verworn, Meyer, and Overton have supplied us with an excellent basis in explanation of the action of anæsthetics, but none of their conclusions are incorporated as principles by our author.

No good would come from pointing out in greater detail the author's failure to emphasize fundamental principles. Indeed, our purpose is not to practice sharp critique, but rather to drive home the fact, pointed out by de Nancrede fifteen years ago, in his "Lectures upon the Principles of Surgery," that many of the excellent works on the principles of surgery are marred, as regards their usefulness, by the attempt to render them too comprehensive. Bryan's volume mirrors industry, care, and thoughtful design. It misses out rather by overreaching than by failure to hit the mark. The book is admittedly intended chiefly for students; it purposes to teach students surgical principles and yet it not only fails to define what a surgical principle is, but also repeatedly confuses the student by encompassing the various principles in masses of data properly belonging to works dealing with the fundamental (laboratory) branches of medical science.

EVERY now and then there appears a book[1] that stirs the selfish heart of the reader to wish himself the sole possessor of the volume, a sensation closely akin to the spirit of the antiquarian who loves his book in a measure proportioned to its scarcity value. One experiences such a sensation on reading the new operative surgery by Krause and Heyman, which has just appeared. The bold, large, wide margined pages, with their beautifully clear type and marvel ously executed illustrations make a lasting appeal on first inspection.

The plan of the work is pretentious. There are to be six volumes in all, of which only the first two have appeared, dealing with the general principles of operative technique and the surgery of the head. The fundamental purpose back of the work is to detail operative procedure both from the purely technical as well as from the clinical point of view. In this we note a similarity to the excellent English work on operative surgery by Jacobson, and a variation from almost all other similar treaties. And just here we may say that these first two volumes furnish excellent testimony that Krause is going to turn out a finished product in every sense of the word.

Volume I takes up in great detail the subjects of preparation for operation, anæsthesia, aspesis, bandaging and after-treatment, the treatment of head injuries, operations for tumors of the face, plastic operations on the face, surgery of the eye, ear, nose, and sinuses, and finally the surgery of trifacial neuralgia. If we say that each of these various subjects is handled in a fashion that mirrors mastery, we shall spare ourselves the impossible task of specific criticism in necessarily limited space. It is a pity that Krause omitted intratracheal insufflation, under the head of anæsthesia, and it is difficult to explain the omission, for only recently, in current literature, he commented on the excellence of the procedure, in head surgery. The chapter on trigeminal neuralgia is a particularly interesting one, in that it furnishes a complete description of all types of operations on the gasserian ganglion and all its branches, and also in that Krause states unequivocally that many cases of trigeminal neuralgia are permanently cured by alcohol injections.

The second volume, consisting of three hundred and fifty pages, takes up the surgery of the superior and inferior maxilla, and the mouth, resection of the temporo-maxillary articulation, surgery of the pharynx, salivary glands, facial, occipital and cervical nerves, and finally, the surgery of the brain. This final part, devoted to the brain, follows very closely the lines developed by Krause in his two volume work on the brain and spinal cord, and is an essential to every one who aspires to know and do neurological surgery.

The most exacting critic who set about deliberately to discover flaws in either of the two volumes would find himself confronting a problem. In the second volume no mention is made of the admirable method of approach to the temporo-maxillary articulation devised by Lilienthal, but even this omission may be overlooked on the basis that Krause is presenting data from the point of view of his own personal experience.

Finally, a critique of these two volumes must call special attention to the illustrations. Even we, in this country, who have grown more or less accus-

[1] LEHRBUCH DER CHIRURGISCHEN OPERATIONEN AN DER HAND; KLINISCHER BEOBACHTUNGEN. Von Prof. Dr. Fedor Krause in Gemeinschaft mit Dr. Emil Heyman. Berlin and Wien: Urban and Schwarzenberg, 1913. Parts I and II.

tomed to the high standard of surgical illustrating set by Broedel with his beautiful ross-board and wash work, must marvel at the accomplishments of Krause's anonymous artist. The plain black and white, as well as the colored plates, are artistic gems; but what is more important, they tell the story of the steps and details of the various operations so clearly that the text often becomes a matter of secondary consideration.

A good book, as well done as this, is an inspiration.

THE wish selfishly expressed above, to own the volumes of Krause to the exclusion of all other readers, might have been attended with a lurking sense of faint shame were it not for the fact that there was to follow the expression of the hope that an equally attractive book, by Kanavel,[1] might be placed in the hands and under the eyes of every medical practitioner. If one were asked to name the classical medical treaties on the hand, he would be safe in venturing as an answer. the monograph in Volkmann's Vortraege by Gerhard—Die Hand des Kranken—and this volume by Kanavel.

Kanavel himself notes the inexplicable fact that although the importance of the subject of acute infections of the hand has been recognized since earliest times, the student cannot find clear descriptions of the various types of disease, with methods of diagnosis and treatment, in either textbooks or special articles. This want is now adequately filled. In his work, of which this is the second edition, Kanavel describes under two heads the simpler hand infections, and the grave infections, under which latter head he takes up tenosynovitis, fascial space abscess, lymphangitis, and allied conditions. His method of developing his thesis is admirable; a general discussion of the important points in diagnosis, followed by the general principles underlying treatment, then four chapters on the anatomy of the hand and forearm as it bears on the surgical treatment of these regions, and finally seventeen chapters devoted to a detailed consideration of the pathology, symptomatology, diagnosis, differential diagnosis, and surgical treatment of the various grave types of infection.

Any man who has enjoyed the privilege of extensive out-patient work, and who has practiced carefully the arts of observation and inductive reasoning, will have confirmed, independently, many of the practical conclusions reached by Kanavel. Those who have not enjoyed such privilege will find that in treating acute diseases of the hand, this book will serve as a *vade mecum* to be trusted under all conditions as a safe, sane, and invaluable guide.

[1] INFECTIONS OF THE HAND. A Guide to Surgical Treatment of Acute and Chronic Suppurative Processes in the Fingers, Hand, and Forearm. By Allen B. Kanavel, M. D. Second Edition, Lea & Febiger. Philadelphia and New York, 1914.

THE excellent reasons why every physician should know medical history[2] are so numerous that they might well be codified; and yet it would seem that the doctors as a class are waiting for some gentle Elia to savor the subject and serve it in the form of *Tales of Old Physic*. However this may all be, we feel that there is a distinct place in a specialized journal of surgery, among reviews of surgical books, for a note on a purely historical work; and if justification is necessary, we plead a pardonable degree of Chauvinism, in that Garrison's History of Medicine is the product of an American. Furthermore, is is not only the most adequate history of medicine ever turned out in our country, but also compares most favorably with any other one volume work produced anywhere, not even excepting Julius Pagel's *Geschichte der Medicin*.

As regards simplicity and beauty of style and diction, adequacy of illustrations, and attractive and orderly development of sequence, nothing is left to be desired. Adhering to the now well-established formula of treating the history of medicine in eras, Garrison discusses, in twelve chapters, the subjects of Primitive Medicine, Egyptian Medicine, Sumerian and Oriental Medicine, Greek Medicine, The Byzantine Period, The Mohammedan and Jewish Periods, The Mediævel Period, The Renaissance, and the Seventeenth, Eighteenth, Nineteenth, and Twentieth Centuries, in order. By the discriminating use of heavy faced type and small print, Garrison furnishes balance to his pages, and, as it were, a foothold to his reader. Furthermore, his admirable interpolations regarding the cultural aspects of the various periods lends a certain charm of personal warmth that is most attractive. For instance, under the head of the cultural aspects of medicine during the 1700 period, he brings us in close face to face contact with many notables, among them, Hunter, Haller, Heberden, and Garth; their doings, their clothes, their earnings; he pictures eighteenth century quackery in a fashion that should, through a sense of historical perspective, assuage us in our wailings concerning present day charlatanry, and bring us peace; and then finally he outlines the status of surgery in the various continental countries, the growth of hospitals abroad and of hospitals and medical schools in America during this era.

The introduction is ostensibly a preface of purpose, but as a matter of fact, it is a charmingly discursive essay on the history of medicine, in which, among other things, a gentle quietus is put upon the doctrine of the enthusiast who advocates lumbering up the already burdened curriculum of the medical school with an obligatory course on the history of medicine.

[2] AN INTRODUCTION TO THE HISTORY OF MEDICINE, WITH MEDICAL CHRONOLOGY, BIBLIOGRAPHIC DATA, AND TEST QUESTIONS. By Fielding H. Garrison, A. B., M. D. Illustrated. Philadelphia and London: W. B. Saunders Co., 1914.